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PRODUCT ENGINEERING

:GRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT · DECEMBER 28,1959

生產的科學研究

SCIENTIFIC RESEARCH WITH EMPHASIS ON PRODUCTION

CHINA BUILDS A TECHNOLOGY...

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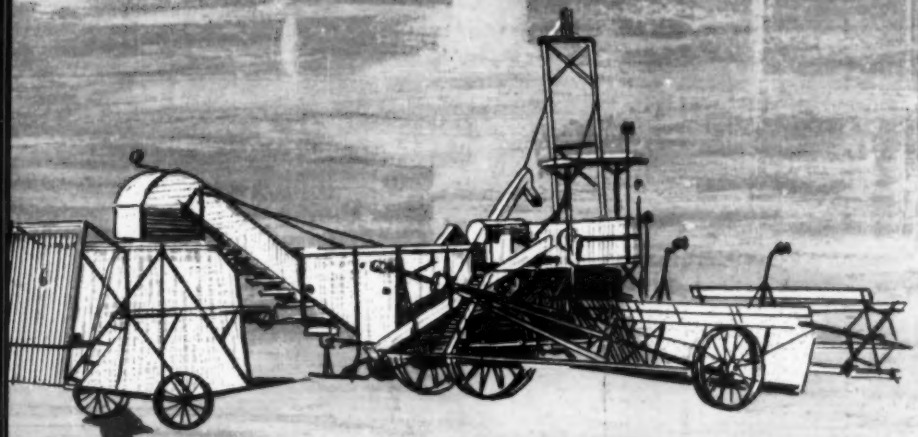

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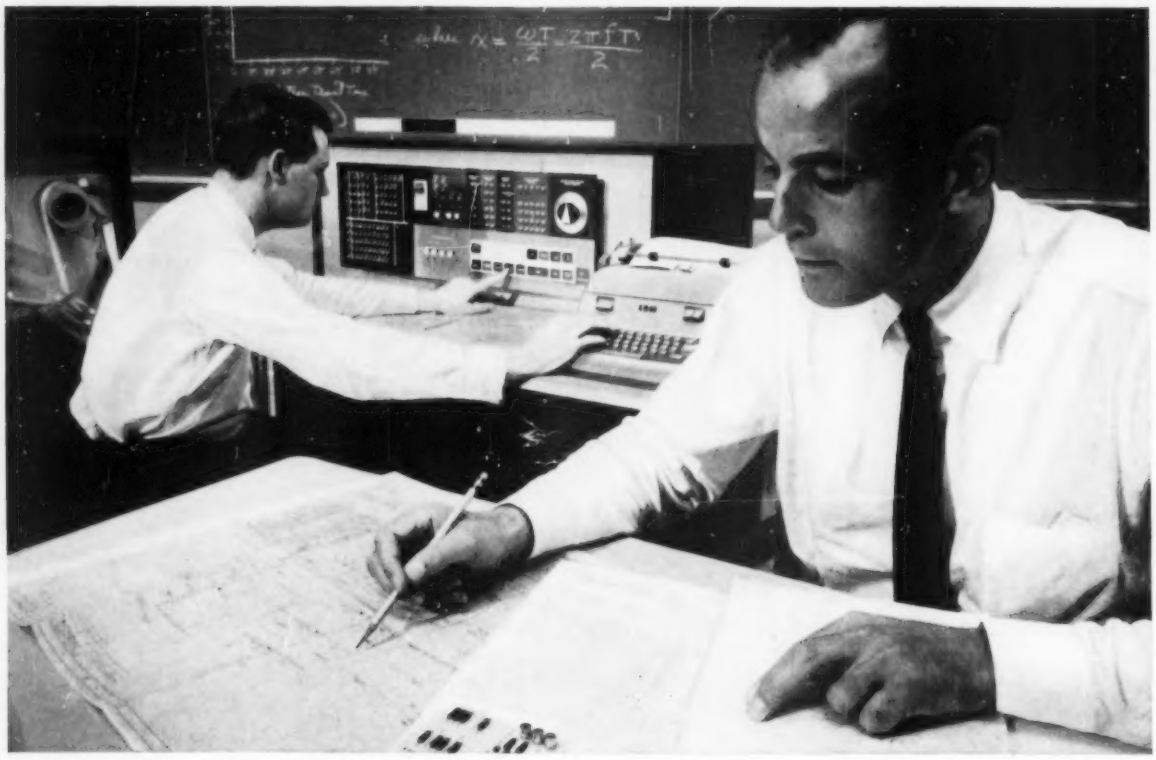

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Product Engineering

McGRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT

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● **The mysterious East** doesn't seem nearly as exotic today as it did in our childhood. China has been sold on science, and while its methods are rough and ready (see p 24), they work, after a fashion. There's a strange parallel here with the Chinese on the West Coast during the California gold rush. Few became prospectors panning the mountain streams for dust. Instead they did laundry and panned the laundry water. It brought a small, but very reliable, return.

● **The fascination of books** is still a strong influence on our lives, despite TV and movies. Early this year our publisher reported that for the first time in publishing history the number of hard-cover books exceeded the number of comic books sold. Now we have another example. The Kodak research laboratory library—devoted only to technical books and periodicals—still attracts 50 to 100 visitors every lunch hour. They skim and browse and add their names to circulation lists of interesting periodicals. The library competes successfully with wide-screen movies, also shown during the lunch hour. Maybe there's a lesson here for all companies—and for Kodak too. Wouldn't a combined lunchroom and library be a wonderful place to spend an hour? It should be a quiet corner, comfortably furnished, and with a good selection of the best periodicals, reference texts, and literature (for when we want a classic we missed somehow and would never otherwise read).

● **Tailpiece.** Those swiveling seats for autos are now made to swing out automatically when the adjacent door is opened. We have an early user's report from Detroit that bears repeating. Seems a prominent Chrysler executive, his wife, and a friend pulled up at Detroit's plush Athletic Club. Eager attendants opened both front doors. The wife, seated in the middle, suddenly found herself deposited on the drive-shaft tunnel. She may be there yet.

ABP December 28, 1959

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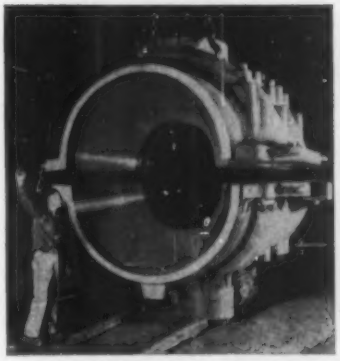

This upper and lower cylinder blade ring for a steam turbine was cast and machined by Blaw-Knox. Weight—55,000 pounds per half.

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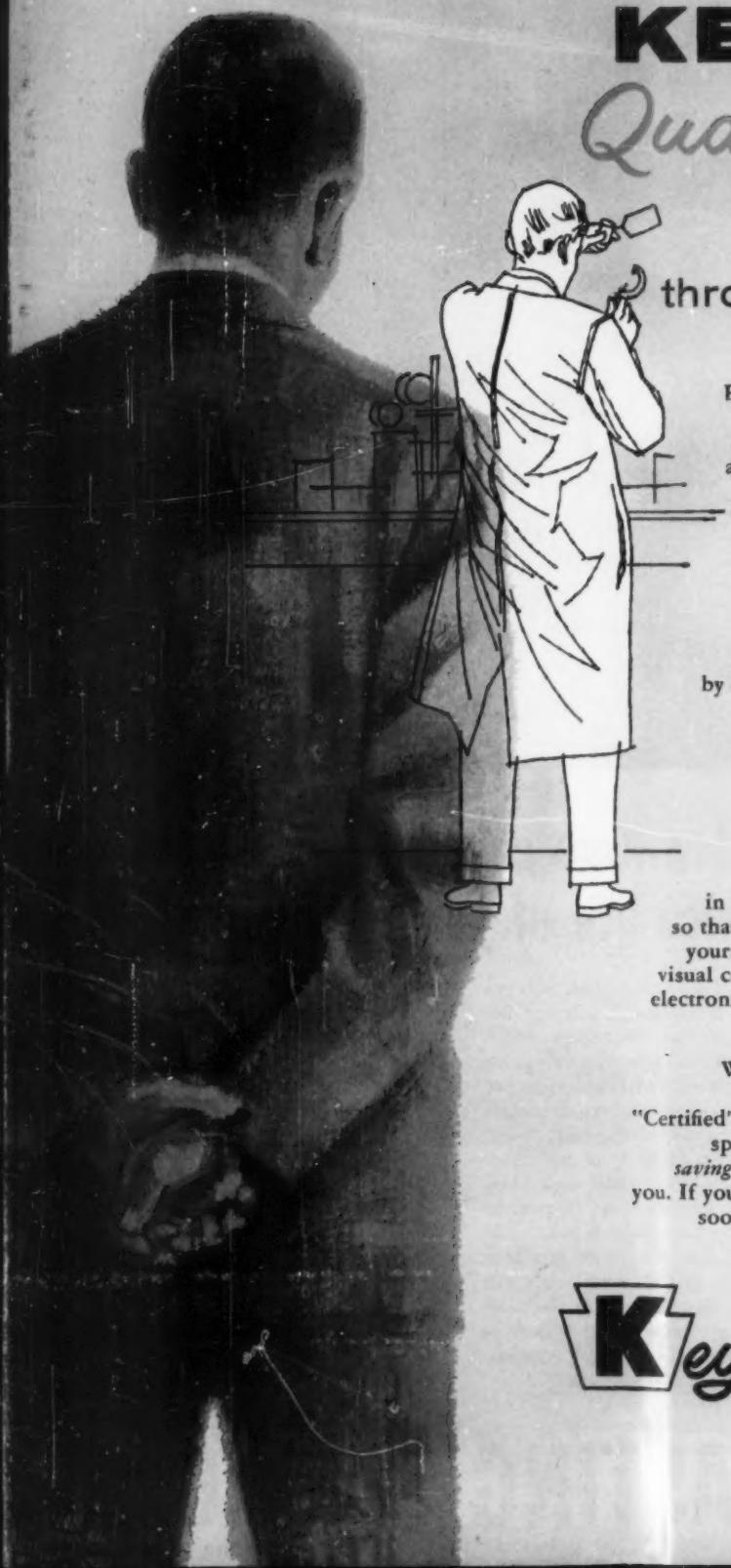

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DEVELOPMENTS TO WATCH...

American

Novel power sources . . .

. . . unveiled during the past month include a solar powerplant (p 10), a ferroelectric converter, a nuclear reactor for space flight, and portable thermoelectric generators, in addition to new fuel-cell systems (*PE*—Oct 26, p 36; Nov 2, p 19).

All demonstrate real progress in this area—but also point up the need for additional research.

The ferroelectric solar-energy converter developed by ITT is capable of generating voltages as high as 1000 v ac or dc, theoretically could produce as much power as 90 w/lb. It's still a long way from that goal, though.

The nuclear reactor for space-flight auxiliary power has been described as "no bigger than a 5-gal. milk can, and weighing only 220 lb." It does promise great savings in weight over conventional batteries for trips of a year's duration. But the quoted size and weight data are a bit misleading. They're for the reactor alone, and do not include either the turbine-generator or the shielding. An ac turbine-generator "the size of a football," and weighing 25 to 30 lb, has been designed to produce about 3 kw; but minimum shielding would add at least 400 lb—and 3 times that much might well be needed. As to cost: present estimates are in the $400,000 range for "production models," and efficiency of power generation is on the order of 6%.

A thermoelectric generator to be made commercially by Pesco Products, is designed to supply power for signaling and detection equipment, and might operate on waste heat from missile exhaust systems and similar sources. Pesco believes the device can eventually be made "as small as a flashlight cell." But demonstration units, using propane gas and supplying power for a small transistor radio, were a good deal larger than that.

Considerably more powerful (and bigger) are several thermoelectric generators being built for the Navy. Already under construction are two 5-kw units. Now, contracts are to be awarded for two 500-w systems, for operation on gasoline or kerosene. (*PE*—Nov 30, p 11) Like the earlier models, they're not expected to be "competitive" in the commercial sense but they should at least pave the way for units that are economical enough for special applications.

New line of hydraulic pumps . . .

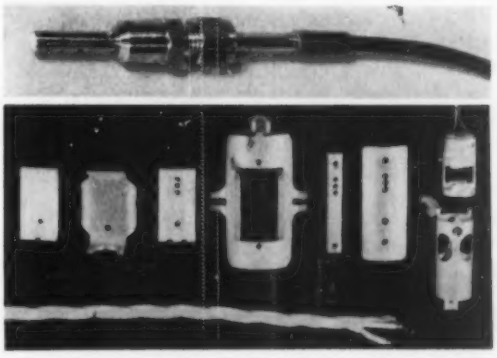
. . . now being market-tested by Parker Hydraulics Div, Parker-Hannifin Co, will mark the company's entrance into the hydraulic pump field. They're designed for installation on mobile equipment (farm tractors, industrial trucks, and the like), for which P-H has long supplied hydraulic valves and fittings. Formal announcement of the first units in the new line, offering capacities of 40, 60, and 80 gpm at 1200 rpm, is expected shortly after the first of the year.

Liquid-level detector for ultralow temperaturers . . .

. . . was designed by Convair Instruments to control height-of-fill in liquid-oxygen tanks by monitoring the liquid-gas interface created as such materials "boil." Now, CI engineers say, they believe it may have much wider application—in processing equipment, pipelines, and heat exchangers.

Basic circuit is a dc bridge in which a 0.001-in. platinum wire serves as one leg. This is immersed in the liquid being monitored. The voltage drop across the circuit then becomes proportional to thermal conductivity of the surrounding medium and indicates whether the wire is immersed in liquid or gas; and thus whether the liquid height is above or below a preset point.

Commercial price for a transducer unit like the one shown in the photograph, designed to mount through the wall of a liquid oxygen tank, will be about $290; amplifier, $250. —ARG



Gas detector consists of resistance element and grid. Unit above, with stainless steel housing, will be sold commercially. Unit, shown disassembled, has anodized aluminum housing, is made by Convair for its own needs.

DEVELOPMENTS TO WATCH...

World-wide

An entirely new route to metal coating . . .

. . . is based on superfluidity, according to its discoverer, Dr Rintaro Takahashi, Japanese scientist of Chiba Institute of Technology. And, he says, the surface of solid matter can be either plated or welded automatically and instantly at a temperature lower than melting point of the base metal which is to be plated or welded.

Superfluidity is a phenomenon which has been observed only in liquid helium until now. It's the strange ability of this element, when supercooled, to "wet" almost any surface.

Why has only liquid helium been seen doing such gymnastics? Says the Japanese scientist:

When this liquid is supercooled, attraction between the helium molecules suddenly weakens and they start to flow away from each other. Other substances have larger molecules than helium and viscosity is also higher, so the effect is small and difficult to detect. But, he finds, when substances are suddenly supercooled near the freezing point, a change can be detected in the specific heat of many metals as the metal changes from liquid to solid state.

His method: an electrical system, using a capillary-tube galvanometer. Two electrodes form a battery cell; one is inserted into the melted substance, the other into the flux. When the melted substance is gradually cooled, its loss of heat energy can be detected continuously as changes in cell electromotive force. Also, when superfluidity occurs by supercooling, loss of energy of molecular attraction can be detected.

Following his theory, Dr Takahashi reasoned that if a drop of a melted metal from an electric spark were dropped onto a surface to be plated and became supercooled as it touched the plating surface, superfluidity should occur, and the drop should spread out instantaneously over the surface.

This, then, is the basis for his new technique.

Only requirement for plating one material onto another, he says, is to clean the plating surface, and to maintain a proper temperature difference between the melted drop and the plating surface in order to cause supercooling.

He predicts use of the process for everything from welding to ceramic coating, and has applied for a patent. Development work is now being done by Fuji Precision Company and Nippon Gaishi (Porcelain Insulators) Company.

Steam welding . . .

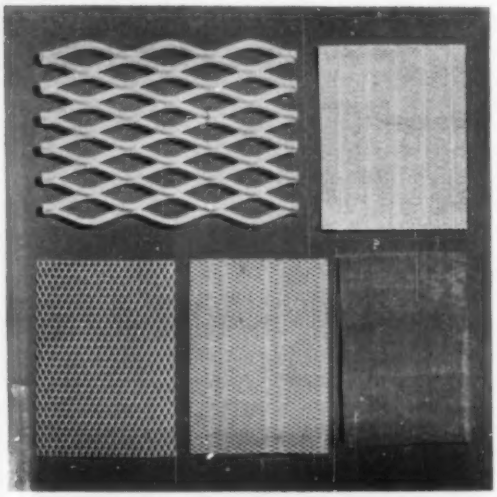
. . . is the latest idea in shielded-arc systems in the Soviet Union. Tests show, engineers say, that water vapor becomes a protective medium—providing a large quantity of moisture at the joint—that prevents weld porosity and improves over-all quality. Standard welding wire can be used. They've designed both semiautomatic and automatic vapor-welders for the job, and prototype units have been built.

Plastics that look and act like expanded metal . . .

. . . are being made available by the British for electric motor guards, radio grilles, battery separators, and a host of other applications. The standard material ranges in mesh sizes from $\frac{1}{16}$ in. to $\frac{1}{2}$ in., and, in most cases, is expected to cost considerably less than comparable steel sheets. (British price for $\frac{1}{16}$ in. expanded polyvinyl chloride mesh is about 30% lower than for comparable steel mesh.) Decorative sheeting and the ultrafine Minimesh, in normal sizes from $\frac{1}{2}$ mm to $1\frac{1}{4}$ mm, for screening, sieving, and filtration, are also going into production.

Expanded Metal Co, Burwood House, London S W 1, is the manufacturer.

US representative is Rainbow Div, Kenway Metals Inc, 186 Third St, Brooklyn 15, N.Y. —ARG



Mesh-like expanded plastic ranges from Minimesh with nearly invisible holes (lower right), to heavy, grating-type sheeting (upper left). The decorative material (with vertical bands) is available in color.

DEVELOPMENTS TO WATCH...

Washington

Chances for more liberal government patent policies . . .

may hit congressional snags. Industry and some sympathetic government officials are plugging to get present government policies liberalized. But, a counterdrive is developing—notably among congressional Democrats—to tighten up on the patent system, instead.

Leading the congressional drive to tighten the government's control over products developed with government financing is Senator Russell Long (D-La), chairman of the Senate Small Business Subcommittee, on Monopoly. Long thinks the government is getting bilked in the deal. Particularly raising Long's ire is a move by Lockheed Aircraft Corp to license Japanese and German firms to build the F-104 fighter plane. After developing this plane under a multi-million dollar government contract, Long says the firm stands to make a $20-million profit in the foreign licensing deal.

Senator Joseph C. O'Mahoney (D-Wyo), chairman of the Senate Judiciary Subcommittee on Patents, Trademarks and Copyrights, thinks the government's present patent policies are hurting small business. "Where title to patents resulting from a government-financed contract is retained by the contractor," O'Mahoney says, "the effect of the government research may be to strengthen the power of a corporation which already has a very large patent portfolio to restrict the competition of small competitors with a relatively insignificant patent position."

The ruckus over government patent policies stems from a move by industry and some government agencies to get uniformity in patent regulations.

The use of boron-base fuels will be continued . . .

in rocket propellant research and development. The Air Force has contracted Callery Chemical Co to produce both liquid and solid boron-base fuels at its Muskogee, Okla plant. This is the $38 million government owned plant that was to be mothballed—before it ever started operating—following the cutback in the military's boron fuel program.

Cost to convert the plant to produce new pentaborine and decaborine fuels is estimated at around $500 million and will take 3 to 4 months.

The fuel production, expected to be less than one-ton per day, will be used for rocket engine research both by the military and National Aeronautics and Space Administration. The original boron fuels program was designed to supply air-breathing engines, primarily for the B-70 bomber program.

Revised cost estimates plus a tight budget ceiling . . .

are forcing the National Aeronautics and Space Administration to junk projects. Being scrapped is its Project Vega rocket program that was designed to boost 5000-lb payloads into earth orbits or carry 1000-lb satellites to the moon.

The project was to cost around $90 million. Convair Div of General Dynamics Corp was prime contractor on Vega and held a $35.5 million contract. Originally slated to be completed by around 1962, NASA said slippage in the planned schedule plus its budget squeeze are the reasons for cancelling the program. Other NASA booster programs, the Centaur and Atlas-Agena, will take over Vega satellite programs, NASA says. Both of these booster programs are built around a modified Atlas ICBM. Centaur, due to be ready by late 1961, is more powerful than the Vega booster.

Cutback of the Vega project will free at least six Atlas vehicles for use in other programs. Speculation is that they will mainly be used for attempts to put a satellite in orbit around the moon. Vega funds, too, will be used to bolster other booster programs.

Although NASA budget in fiscal 1961 is reported to be around $800 million—compared with around $500 million this year—revised costs of projects is putting a dollar squeeze on the agency. The top priority Project Mercury that is designed to put a man into orbit, for example, is now estimated to cost close to $350 million. This is some $150 million over the original estimates. The cost increase is not due to rising prices, NASA says, but rather to more complex designing as the program advances. First manned flights are now estimated to come some time in late 1961.

Shifting of the Army's Saturn Rocket Program to NASA is putting a drain on the agency's funds, too. Reports are that NASA will increase spending on the Saturn project next year to around $140 million—double this year's $70-million expenditure. This, obviously, takes a big bite out of the agency's increase in funds for the forthcoming year. Unofficially, the agency was slated to ask Congress to up its budget to around $750 million even before the Saturn program was transferred to it.

WHAT'S HAPPENING IN... Science

Double exposure highlights motion

To emphasize motion and point up time differences, R. S. Mackay of U of California Radiation Laboratory has devised an interesting technique.

Basically, it is a double-printing system, using a positive and a negative, superposed and offset in such a way that the stationary parts of an assembly are darkened; while those in motion are highlighted (see illustration).

The technique can be applied to still and motion pictures, and to video tape. When tape is used information can be immediately displayed. A double-pickup head can feed the two outputs to a difference amplifier. Or, if desired, the incoming image can be directly converted for display by splitting the signal along two paths, one going toward the output device and one to the recording head of a video recorder. (The read-out head "plays" into the output device, which contains a difference amplifier, and thus displays the difference between the signal at this stage and the signal at a fixed previous time.) Here, the tape recorder functions as a delay line; but MacKay says any other memory device or circuit could function similarly if it has sufficient storage capacity and speed.

With color, there is still another possibility: dyeing two films in different colors to form a finished double-image print.

Muscles flexed for motorless flight

Man-powered airplanes are now receiving serious attention from Britain's Royal Aeronautical Society. And, reports from Britain say, an ornithopter and a fixed-wing project are nearing flight test at Queens University.

The British scientists are not simply thinking in terms of braked-fall takeoffs from high cliffs. They do not approve, either, of the Russian approach —ultralight auxiliary motors.

They are aiming strictly and specifically at airships which will travel by virtue of the muscular efforts of the men inside them.

Moving hand of stopwatch is emphasized by double-printing technique. Black arm is stationary; the white one has moved.

They recognize, on the other hand, that even with the lightest possible airframe, man would have only one-fifth the muscle weight to total weight ratio of a bird (its muscle weight is nearly half its total weight); and man's muscle power is rated at only about 0.006 hp/kg—some 300 times less than that of a conventional engine.

Man's peak power (for takeoff) and his sustained power (for cruise) are also limited. Even a good athlete can't achieve a peak of more than 3 to 5 hp —and then only for a few seconds; and his "cruising power" is less than ½ hp.

Man has one consolation, though: In sail planes he can develop a lift-to-drag ratio considerably better than that of the birds. In flapping flight, the best they can do is 18:1; in regular flight, 5:1. Man can develop a ratio of 26:1.

Still, the scientists believe that man can fly—for short periods at least. Right now, major attention is being given to wing design, with a span of about 50 ft and an aspect ratio of about 15 being favored. There are, however, other possibilities, including kite designs. Balsawood or plastic, covered with plastic film, might be the materials of construction. For such a design, the fastening system would be crucial and will require considerable ingenuity. The drive might resemble that of a racing bicycle.

Still literally up in the air are such questions as optimum propeller design, undercarriage wheeled or sled), and fuselage design.

briefs . . .

Powerplants for the moon are already being designed, though even the optimists admit it will be a while before they're put to use.

At the ASME annual meeting, D. B. Mackay and E. L. Leventhal of North American Aviation described a solar-powered turbine-generator consisting of a parabolic mirror and a series of boiler tubes. The system is simple, but choice of working fluid is a critical factor; and none of the available fluids is entirely satisfactory. Best choice right now seems to be mercury, also used as the working fluid in the AEC's miniature reactor (see p 7). But even this would require about 35 sq ft of mirror area per kw generated.

Natural oils that are receiving serious attention for fire-retardent paints, varnishes, binders for brake linings, and additives for plastics, include such familiar materials as soybean oil and relatively unfamiliar ones as isano oil, imported from Africa. Among the other vegetable oils already in commercial use for such applications, Pacific Vegetable Oil Co says, are tung, rice (*PE—Dec* 22 '58, p 22) rapeseed (*PE—June* 30 '58, p 8), castor, and oiticica.

Neutron-absorbing bricks that are relatively low in cost can be made from calcium boride, says Naval Research Laboratory. Far less expensive than boron carbide and less bulky than borax, the CaB_6 bricks can be made by compressing a thick, dry "mud" at about 2000 psi and baking at about 1400 F for 2 hr. They're "fairly high" in density, resistant to radiation, and durable in storage. —ARG

WHAT'S HAPPENING IN... Materials

When metals ignite

High-temperature operation of jet aircraft and other equipment is making combustion of metals–solid metal in thick sections–a serious problem; and very little is known about it.

Even the mechanisms of burning and ignition have not been fully understood. They're not exactly the same.

As W. C. Reynolds of Stanford U points out in an NASA report, ignition is brought about by "an exothermic oxidation reaction between the solid metal and its gaseous environment." It is mainly an extension of the slow oxidation of all metals, even at room temperature.

Burning, on the other hand, may be a surface reaction, or else a vapor-phase reaction that occurs at some distance from the surface. "It is conceivable," he says, "that a body could ignite but not burn, the ignition leading simply to melting."

His own studies have been concerned primarily with ignition; and he cites figures like these:

Metal	*Ignition Temp, °F*
Mild steel	2240
Tungsten	2270
Titanium	2880
Stainless 430	2460

Stainless 302, copper and nickel all melt before igniting, as do aluminum, zinc, lead and other metals.

Aluminum to replace steel?

Just six years ago, aluminum, the one-time upstart, passed copper in total tonnage produced; and the gap is widening fast. The copper-based lamp bulb is becoming a museum piece, with the copper bus bar soon to join it. One producer, for instance, is already 70% converted.

Now there is talk of aluminum "replacing" steel in everything from cars to houses.

Aluminum usage is indeed increasing–up several hundred percent in cars in the past few years. But that kind of figure can be misleading. The average car today uses less than 60 lb of aluminum . . . and 2500 lb of steel.

The fact is, even if someone were ready to produce an all-aluminum car, he'd have a hard time finding enough aluminum to do the job. Even at full production, less aluminum is produced than came from the steel mills at the low point of the strike. (The all-time record for aluminum is 179,194 tons/month. Steel production at the low of the strike averaged 360,000 tons/month.)

The fact is, aluminum has a long way to go before it replaces steel–in performance, price or availability. Even the most optimistic experts do not foresee aluminum reaching the 10-million-ton-a-year mark before the mid-1980s; while steel production in "normal times" is ten times as large. Actually aluminum works with steel more than replacing it, as the record during the steel strike has shown. Far from rising, aluminum consumption dropped. The reason: those products which use the most aluminum use even more steel. No steel means no product–and reduces the outlet for aluminum.

Materials: key to reactor costs

When will "cheap" power from the atom become available? One answer: when materials costs come down. They're moving in the right direction. But they have a long way to go.

When it comes to nuclear reactors, just about the cheapest material so far is the uranium "fuel" itself. It's $24/lb for the "natural" metal; only $65/lb for metal that's been enriched 25% in fissionable U 235. That's not far from the going price for the nuclear grade of other materials used:

Beryllium: $48 to $71
Zirconium: $20 to $30
Columbium: $35 to $85
Vanadium: $35 to $50
Tantalum: $35 to $60
Chromium: $4.50 to $28

And these are ingot prices. Sheet is often 50 to 150% higher.

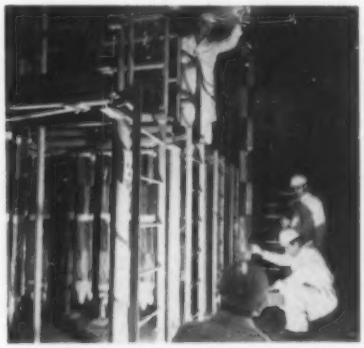
Even standard materials take on new price tags when needed for reactor use, often doubling or tripling in price.

The trouble is that, for a reactor, metals must be virtually free of such elements as boron and hafnium which gobble neutrons and tend to slow down or stop the power-producing chain reaction, and elements like cobalt which become highly and dangerously radioactive.

In some cases, removing the offending element is not too difficult. In others–separating zirconium and hafnium, for instance–it is so difficult and costly that it was once labeled "impossible"–on a production basis, at least. It's done regularly now; but hafnium-free zirconium averages 40% costlier than the commercial high-purity metal.

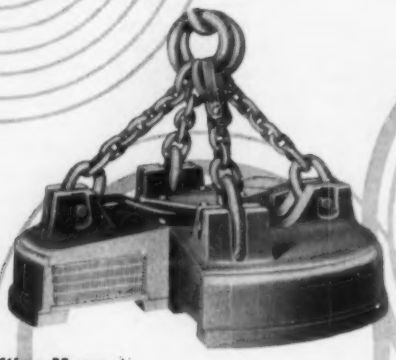
One encouraging note: all these prices are far lower than ten or even five years ago–and research promises even lower prices for the future.

Furthermore, a great deal can be done to reduce final costs by improving fabrication techniques for these new materials. Right now, for instance, it costs twice as much to fabricate fuel elements with zirconium cladding (see photo) as with stainless steel–and stainless itself is not exactly an easy material to form. –ARG



Fuel elements for big Dresden reactor, built by GE, are zirconium-clad uranium oxide. Total fuel element weight, about 66 tons; cost, $15,000,000.

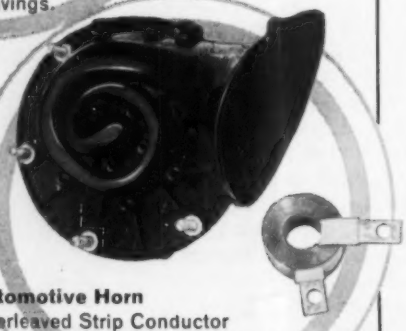
REYNOLDS STRIP



Dings Lifting Magnet
100% productive use of coil space for a more powerful, lighter weight magnet, designed with Reynolds Anodized Strip Conductor.

Controlarc DC Arc Welder
A lighter weight, more rugged unit capable of withstanding severe overloads, thanks to Reynolds Anodized Strip Conductor.

A. O. Smith AC-DC Convertor
More performance packed into a smaller housing—Reynolds Anodized Strip Conductor eliminates bulky insulation. Good production savings.



Sparton Automotive Horn
Reynolds Interleaved Strip Conductor eliminated eleven parts, provides improved performance, production efficiencies.

SOME LEADING MANUFACTURERS AND THEIR APPLICATIONS OF REYNOLDS ALUMINUM STRIP CONDUCTOR

Caledonia-Transformer
1955 Electronic Transformer, Interleaved Sheet

Dings Magnetic Separator
1956 Lift Magnets, Anodized Strip

Vickers Electric
1956 Transformer Welder, Anodized Strip

Harnischfeger
1957 Clutch Coils, Anodized Strip

Lincoln Electric
1957 Arc Welders, Interleaved Sheet

Jefferson Electric
1958 Dry-type Transformers, Anodized Strip

General Electric
1958 Control Coils, Interleaved Foil

Calidyne
1958 Shaker Coils, Anodized Strip

Delco Remy
1958 Alternator Field Coils, Interleaved Foil

A. O. Smith
1959 Arc Welders, Anodized Strip

Cutler Hammer
1959 Lift Magnets, Anodized Strip

Westinghouse
1959 Specialty Dry-type Transformers, Interleaved Sheet

Sparton Automotive
1959 Horn Coils, Interleaved Foil

ALUMINUM CONDUCTOR

Reynolds 1955 development continues to find new uses in improving products and reducing costs in the electrical industry

Four years of progress is paying important user dividends

Introduced in 1955, Reynolds Aluminum Strip Conductor—anodized and interleaved—was hailed immediately as an excellent new way to solve numerous production problems and costs associated with conventional wire coils.

A pilot laboratory for winding strip coils was established and hundreds of varying sizes and types were prepared. During this time, Reynolds Product Development Department worked with many electrical equipment manufacturers. This pooling of talent helped hasten and expand the practical application areas for Reynolds Aluminum Strip Conductor. As an example, the Utica Koldweld Division of Kelsey-Hayes assisted Reynolds in developing new tools and methods for the joining of the conductor.

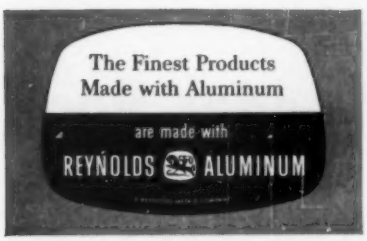
Year by year, new uses have been found for Reynolds Aluminum Strip Conductor in a wide variety of electrical equipment. The first production use was in 1955 in electronic transformers made by the Caledonia Transformer Company; the most recent is this year's use in new automotive horns made by Sparton Automotive. And over the years, Reynolds Aluminum Strip Conductor has been used in lift magnets, transformers and convertors. Its potential in large and small equipment is almost unlimited.

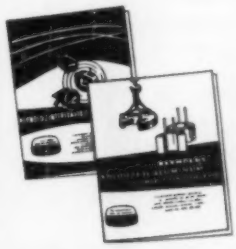
Winding ease . . . insulation savings . . . improved heat transfer . . . reduced layer-to-layer voltages: key benefits offered by this proved product

Reynolds Aluminum Strip Conductor eliminates bulky insulations. It lessens the danger of burnout by offering better heat transfer characteristics, reduces layer-to-layer voltages, increases coil efficiency. In manufacturing, it provides exceptional winding ease and simple mechanical joining. And with its high conductivity and low weight, it saves both space and weight. These benefits, and others, add up to a better coil, a less expensive coil.

Reynolds Aluminum Strip Conductor is available in two forms: interleaved or anodized. The interleaved form is furnished by Reynolds in coil form and can be wound with the customer's choice of interleaving material. Anodized strip is customarily used in the heavier gauges in transformers, magnetic clutches and brakes. Whatever the choice, you can depend on Reynolds, the acknowledged pioneer in the development of aluminum strip conductor.

For more information contact your nearest Reynolds Sales Office or write direct to *Reynolds Metals Company, P.O. Box 2346-HN, Richmond 18, Virginia.*

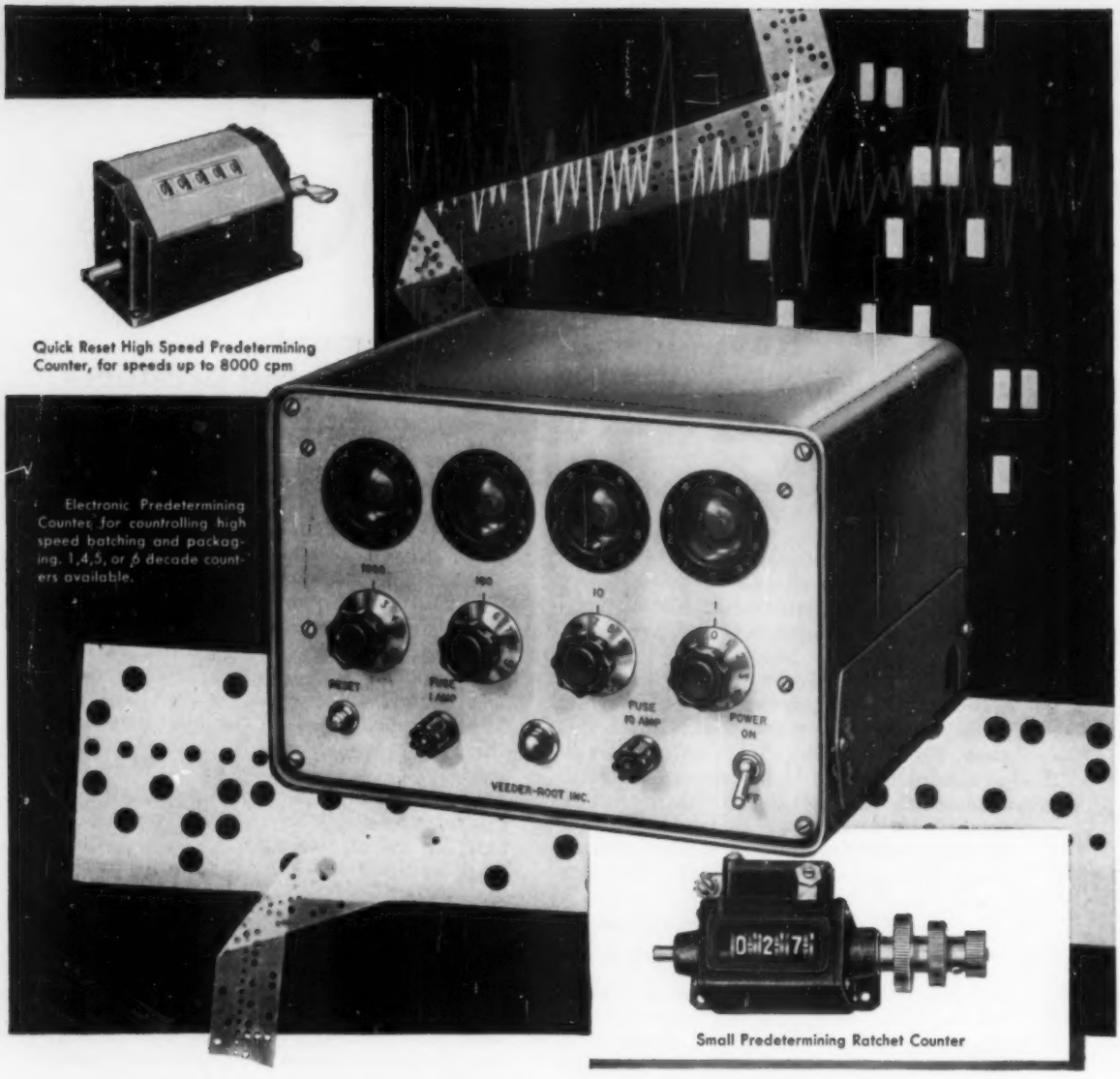




WRITE TODAY

for these booklets on Reynolds Anodized and Interleaved Strip Conductor. They contain information on actual applications joining and winding and a wire gauge-strip conductor computation chart.

Watch Reynolds TV shows—"ALL STAR GOLF", "BOURBON STREET BEAT" and "ADVENTURES IN PARADISE"—ABC-TV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VR-52

Product Engineering — HORIZONS

December 28, 1959

The Paradoxical Idea-graph

Disaster Advantage

Antibiotics that stopped centuries-old sicknesses dead are found to attack some humans and to encourage some viruses to a hardier strain . . . Cranberry sauce for the traditional holiday dinners was viewed with Federal suspicion this year because some growers used a modern bug killer that may also be toxic to humans . . . The Army suddenly abandoned its plans for a big irradiation center to sterilize and preserve food—not because irradiation is dangerous but because it destroys vitamins . . . Fission and fusion, either one, uncontrolled, can destroy the lives we try to save with them . . . The automobile and the airplane, which carry man at amazing speeds to shrink our earth, are also man's deadliest tools . . .

Perhaps it was paradoxes like these that the ancient Chinese had in mind when they linked two sharply contrasting words, disaster and advantage—by representing both with the same ideograph. At least, they seem at first blush to contrast sharply. But do they? Doesn't maximum advantage always carry in the background the possibility of disaster as well?

This is obvious enough in atomic development, not so obvious in starting a new business, or undertaking a new product. But gain or advantage is always associated with risk—physical, financial or other. The opportunity-taker is inevitably asking for trouble.

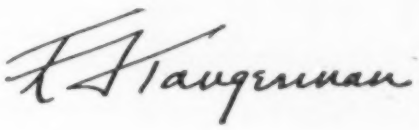
Most Americans, like most Chinese, will not learn this particular ideograph—they'll never take the chance or court the disaster that it suggests. Too many of us go on letting others take the risk associated with new ideas; we "play it safe," coming in for the leavings like jackals after some lion makes the kill.

This has been the history of invention in every field. The bold thinker and the entrepreneur make the break-through, only to be challenged by the "me-too" and "just-as-good" boys, the apostles of the price-cut.

Any entrepreneur is resigned to this. He knows that some investment in time and money must precede a breakthrough in any direction, and that only fast action will permit him to recapture either or both. And that self-same fast action will cost still more time and money.

In many cases, patents and secret processes are little or no protection —patents are largely a license to sue infringers, an expensive procedure, and secret processes cannot today stay secret for long. This is discouraging to innovators, many of whom are unsupported by developmental capital, but it is their major advantage at the same time. The small company and the compact organization can move fast; the big organization cannot. So the big organization's resources are balanced by the small one's speed.

Our point: learn this idea-graph and remember it. When the idea comes along, move fast and far. Take the opportunity and run with it; your major advantage over competitors and copyists is time.



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That Curtiss-Wright Announcement—Germans Now Strip Some Mystery from Rotary Engine; Detroit Professes Little Interest

NEW YORK—When Roy T. Hurley, Curtiss-Wright president, announced a turbine-like gasoline engine a month ago (*PE*—Dec 7, p 44), he left many design questions unanswered. Engineers wanted to know: Had C-W and its West German associate, NSU Werke, solved the sealing problem inherent in all rotating engines? Had they worked out ways to produce the crankshaft, rotor and combustion chamber to precision tolerances? Was fuel economy as good as indicated—or is cost raised by mixing unrecoverable lubricating oil with the gasoline? Hurley spoke of a 100-hp unit weighing 1 lb/hp, but added few details. To serve its readers, PRODUCT ENGINEERING has sent its overseas editors to NSU Werke, inventors of the engine, for more facts; we have also checked effect of the C-W announcement on US manufacturers of automotive, aircraft and off-the-road equipment. Here are the answers.

1961 Production Scheduled

BONN, GERMANY—First of the rotating engines should come off the line in 1961, according to Arthur Westrup, an NSU spokesman. This will culminate eight years of intensive research by engine inventor Felix Wankel and NSU chief designer Dr Walter Froede. A 125-cc prototype tested in 1957, said Westrup, produced 32 hp (SAE) at 17,000 rpm. It weighed 11 lb and used less than ½ lb of fuel per hp-hr.

NSU has approached German machine-tool makers with plans for building the special tools (particularly high-accuracy grinders) required for machining the complex-shaped epitrochoid chamber and the triangular rotor (see pp 18, 19). A special grinder for epitrochoid contour was designed by Prof Baier of Stuttgart Institute of Technology. However, all other components can be machined to normal engineering tolerances. NSU believes cost of producing the engine will be far below cost for a conventional internal combustion engine.

The Sealing Material?

Sealing has always been a problem in such engines, but NSU believes it has the problem licked. Each rotor apex has a strip seal made of special heat- and wear-resistant metal. Though actual composition is secret, the metal is said to be tough but resilient. Main drawback, says NSU: the fuel is fired always at one spot. This means the chamber wall at this point is subjected continually to excessively high temperatures as the gas-air mixture explodes. NSU says special treatment given the wall enables it to withstand these high temperatures and stresses; the seal is in no way impaired.

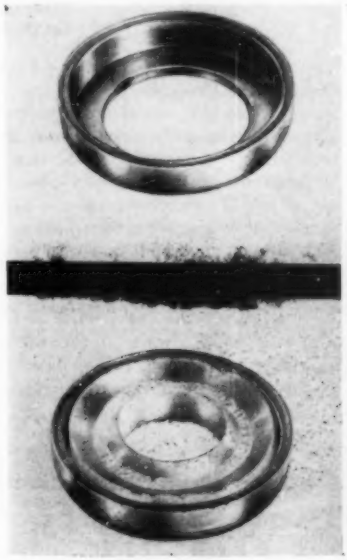
NSU gave this example: A C-W test with a 100-hp prototype ran at full load for 300 hr. Wear was normal. Engine was then reassembled and ran for another 100 hr with no appreciable increase in wear.

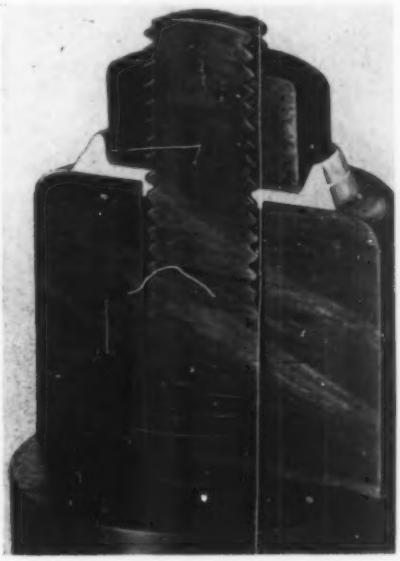
Pressure Lubrication Coming

Prototype engines now installed in NSU's car—Prinz—run on a gasoline-lube-oil mixture. Good results are claimed for up to a 100-to-1 mixture, but 25 to 1 is being used. This is fine for small-hp units, but smoke and air pollution would probably occur

Prize-winning Lockwasher

The Dubo lockwasher, a Dutch locking and sealing device with double retaining powers is quipped with double, T-shaped retaining rings made from nylon. When ring is placed on a bolt and nut is tightened, Dubo ring begins cold-flowing action. Inner dia grips into the threads of the bolt and nut, flowing into the opening of the tapped hole. Simultaneously, outer dia flows over outer edges of the nut, securely locking and sealing it. Forcing nylon into screw threads of nut and bolt eliminates danger of leakage. N. V. Dorned, maker of the lockwasher, reports that it resists corrosion, chemical agents and wear—may be used up to 50 times. It won first prize at the recent Euromarket Fair at Strassburg.





at higher hp, NSU admits. However, the company claims it has developed a system enabling lubricant to be pumped at pressure to friction points. NSU declines to say how the chamber walls are lubricated but calls the method satisfactory—with no problems expected.

Fuel consumption is low and compares well with a diesel test car, NSU adds— outstanding fuel advantage is efficient operation on gasoline with octane number as low as 43. Shortly, NSU hopes to start bench-testing one of the rotating engines with diesel fuel and an injector replacing the spark plug.

* * * * *

US Tractor People Lukewarm

CHICAGO—In a check of mobile-equipment manufacturers here, none sees need for the C-W engine—and at this time—none has been approached about it. Most of the agricultural, truck and tractor plants here make their own engines and say they would not want to upset production lines for a new and untried unit. A few buy engines. They say they "don't need the power produced by the C-W engine," "wouldn't want to use it at this time," "it is too new and untested," or "are satisfied with the engines they are now using."

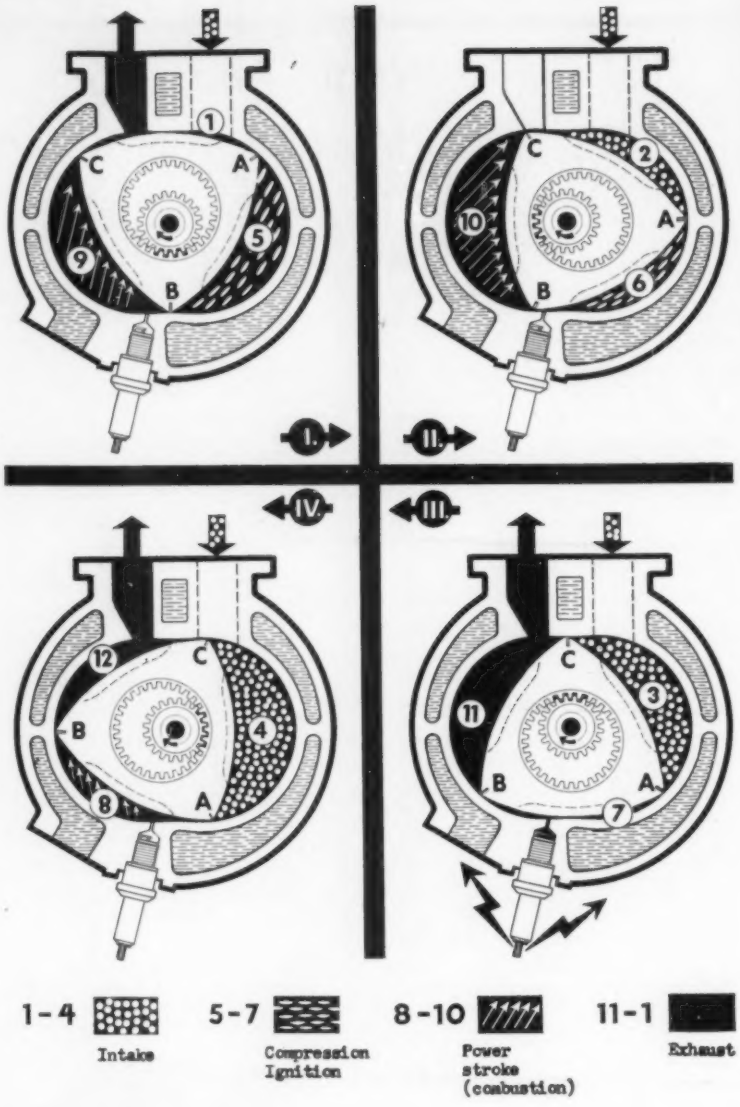
* * * * *

Motor Capital Sees Paradox

DETROIT—Automobile spokesmen here react with everything from an outright "no interest" to "if we could get one for test we would." When Curtiss-Wright announced the engine, PRODUCT ENGINEERING hears, the Detroiters remembered that NSU representatives toured the US auto industry two years ago in an unsuccessful attempt to sell the concept.

Objections at that time pinpointed the rotor, with its complex shape, as being costly and difficult to manufacture. Detroit also saw these problems: A serious problem in profile milling and grinding, the problem of properly cooling and lubricating the rotor. In the early version, at least, the lubricant is continually exposed to combustion—creating much smoke, not to mention inability of the oil to seal.

Detroiters also point to this paradox: If C-W and NSU have in the past two years solved all the design problems, why are offers to purchase prototypes for evaluation being turned down?



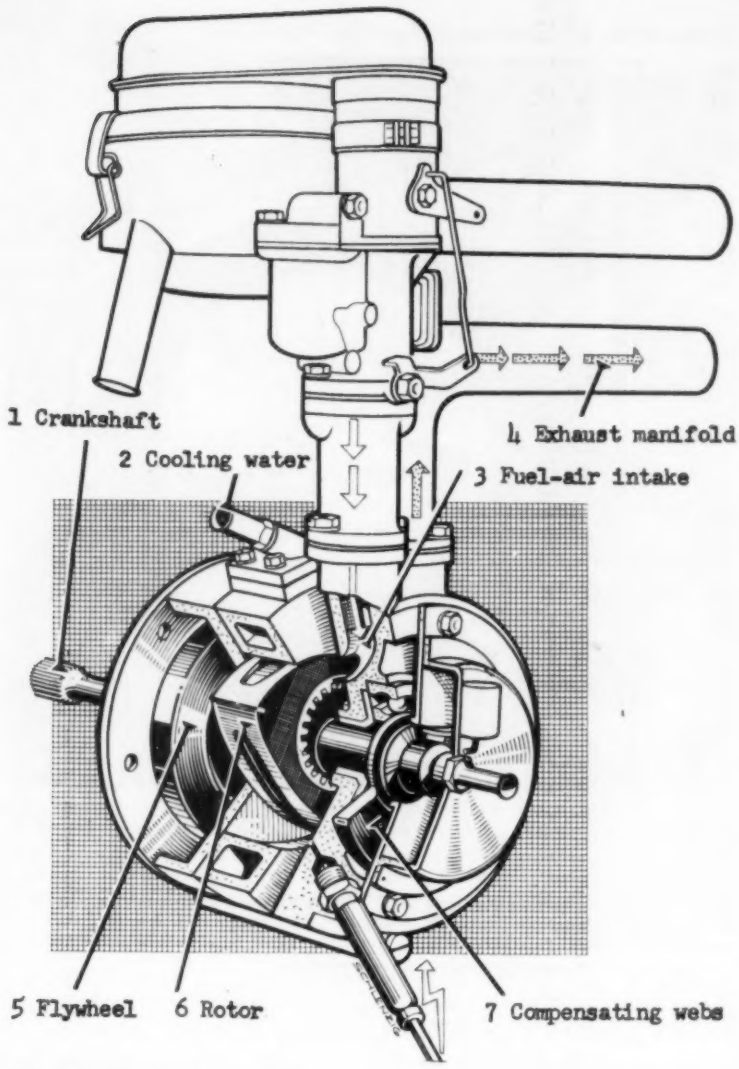
Triangular-shaped rotor . . .
moves eccentrically inside the "figure-8" chamber, has oval-shaped depressions on its surface. At (1), combustion chamber is at minimum size and taking in fuel-air mixture from a standard automotive carburetor. Through (2) and (3), combustion space increases until max size is reached at (4). Here, mixture intake ceases and is compressed through (5), (6) and (7). Max compression is at (7), where combustion chamber is again min size. Ignition occurs over single spark plug. Exploding gas expands rapidly through (8), (9) and (10). As apex of rotor uncovers exhaust port (11), spent gases are released (12).

* * * * *

Germans Claim World Patents

WASHINGTON—Military services agree with C-W's president Hurley that the engine is a C-W development with no government backing. The services have asked for more information but, as yet, nothing is forthcoming.

The Patent Office has checked its files and claims it can't find any patent grants to C-W on the engine, or any information regarding its German origin. But, they concede, they would not necessarily know about the Ger-



Major components . . .
are shown by section through NSU engine. Rotor is mounted on crankshaft by means of cam which gives rotation its eccentric course and keeps rotor apexes pressed against chamber wall. Such mounting and by gearing rotor speed down to ⅔ speed of crankshaft, rubbing speed between apexes and wall is low enough to allow effective sealing, NSU claims. Flywheel and compensating webs are secured to the crankshaft. Webs act as counterweights to counteract any out-of-balance forces.

man side of the picture.

Latest information from NSU says the engine is covered by more than 60 patents in all countries except Red China, which does not recognize patents. US patent authorities, NSU claims, at first refused to grant patent application because they considered the whole project "a flight of fancy."

* * * * *

Aviation's Reaction

LOS ANGELES—Aircraft industry spokesmen here say they are in the dark about this particular engine, but claim similar ideas have never proved airworthy. They admit they would like more information about C-W's engine and would willingly test one of the multichamber units.

* * * * *

C-W's Reactions

NEW YORK—A check of C-W offices and manufacturing plants in the US and Canada turns up the information that they know nothing more about the engine than has been released by the parent company.

C-W, Santa Barbara, Calif, is to manufacture the engine in the US but does not yet have details about it. Canadian Curtiss-Wright Ltd is slated to build the engine in Canada but also says it knows nothing about it. And production, according to Dr P. J. Stewart, manager of the firm's Oakville operation, "is a long way off."

The latest series of C-W advertisements extolling the value of "Technology and Independent Action Under the Free Enterprise System" is believed by many to be an answer to the SEC investigation into C-W's stock fluctuations following announcement of the engine and the 50% cut in company dividends two days later. ■

FTC Proposes Fluorocarbon Standards

WASHINGTON—At the request of the chemicals industry, the Federal Trade Commission is writing a set of trade practice rules for the fluorocarbon-makers. Fluorocarbons, derived from resins and made into gaskets, bearings, machine coatings, etc, will be covered by the proposed rules.

These resins have gained wide use in electronics, missiles, jet aircraft, and other industries. The plastic is slippery and can be made into greaseless bearings. It is unaffected by acids and caustics, and withstands temperatures ranging from −300 to 500 F.

Main producers of the basic powder are DuPont (Teflon) and Minnesota Mining and Manufacturing (Kel-F). Some 350 firms process or fabricate the material.

FTC has presented a draft of proposed rules to an industry conference. Public hearings will be held prior to adoption of the final code. The FTC action attempts to curb a variety of unfair practices including misrepresentation of materials standards (the commission has asked the Commerce Dept to set commercial standards), substitution of products, deceptive invoicing, cost cutting, fictitious prices and price lists, and false disparagement of competitor's product. ■

Calif. Beats Bushes for Safer Truck Brakes

LOS ANGELES—Failure to define exactly what constitutes a truly dependable braking system for trucks and how to go about achieving it may torpedo final enactment of a safety law slated to go into effect in California on New Year's Day.

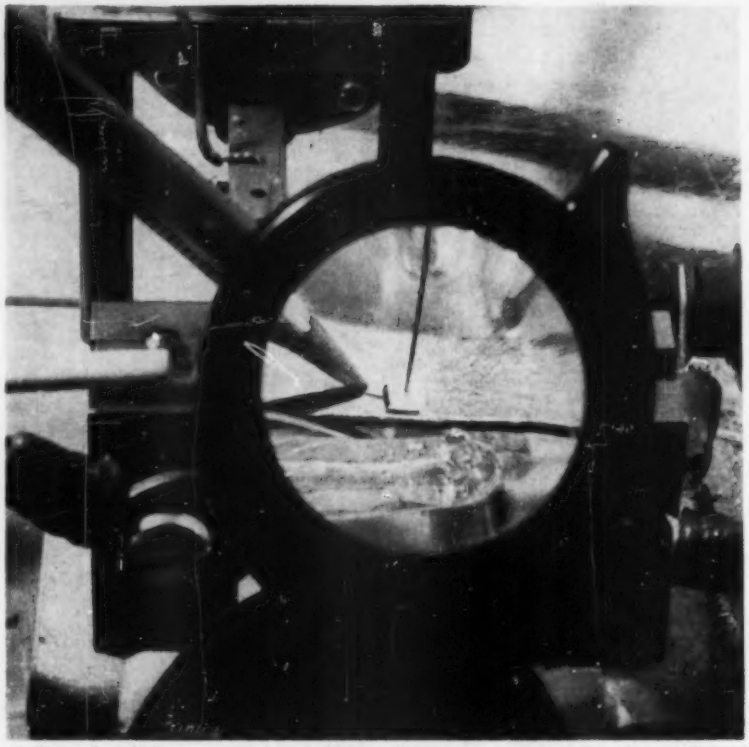
Recently, Gov Pat Brown signed Legislative Bill S-1073 which decrees that "every vehicle using compressed air for the actuating of brakes shall be equipped with a safety device approved by the State Highway Patrol (SHP); said device to prevent loss of air pressure if an air line should break or a diaphragm should rupture, and must permit effective application of the remaining brakes of the vehicle, or other safety devices approved by SHP which will upon loss of air pressure, automatically apply the brakes to the wheel of the vehicles."

The impending enactment of S-1073 ignited indignation in the truck industry and its suppliers who suspected that SHP leaned toward approving a mechanical loading system that would result in the sudden application of braking without knowledge or control of truck drivers. The industry pressured the SHP for a public hearing in Sacramento to explain its reservations about mechanical loading.

Truckers argued that cost of such a system runs to about $100 per axle, and that uncontrolled braking in congested areas, or main arteries, could be a hazard because once spring-loaded brakes are applied, they can't be released until the entire system is repaired.

A promising device is now being tested by Hydro-Aire Inc, whose Hytrol antiskid systems are used in the aircraft and truck industries. It is a small valve unit mounted like a T-connection to supply air to two brake cylinders on the same axle. It works on a delayed feedback of air pressure from the lines running to the actuators. Sensing too high a pressure drop for too long a period, it automatically closes off the leaking line, permitting the other brakes in the system to function as usual. Priced under $25, it requires few spare parts as it is designed to make maximum use of components already used in Hydro-Aire's anti-skid system. ■

Forerunner of Electronic Family



Gallium phosphide, a material resembling yellow ground-glass and said to withstand temperatures up to 1500 F, will be used to make cores for tiny electrical devices required in space vehicles. Here, a tiny crystal of gallium phosphide (size of crystal is magnified in contrast with pencil point) operates in test apparatus as an electronic diode at 1500 F. The compound was developed at US Army Signal R & D Laboratory, Fort Monmouth. Engineers there say material is forerunner of entire new family of transistor-like devices that operate in intense heat. Gallium phosphide is composed of two elements which separately melt at low temperatures.

Battelle Opens Doors to Private Irradiation

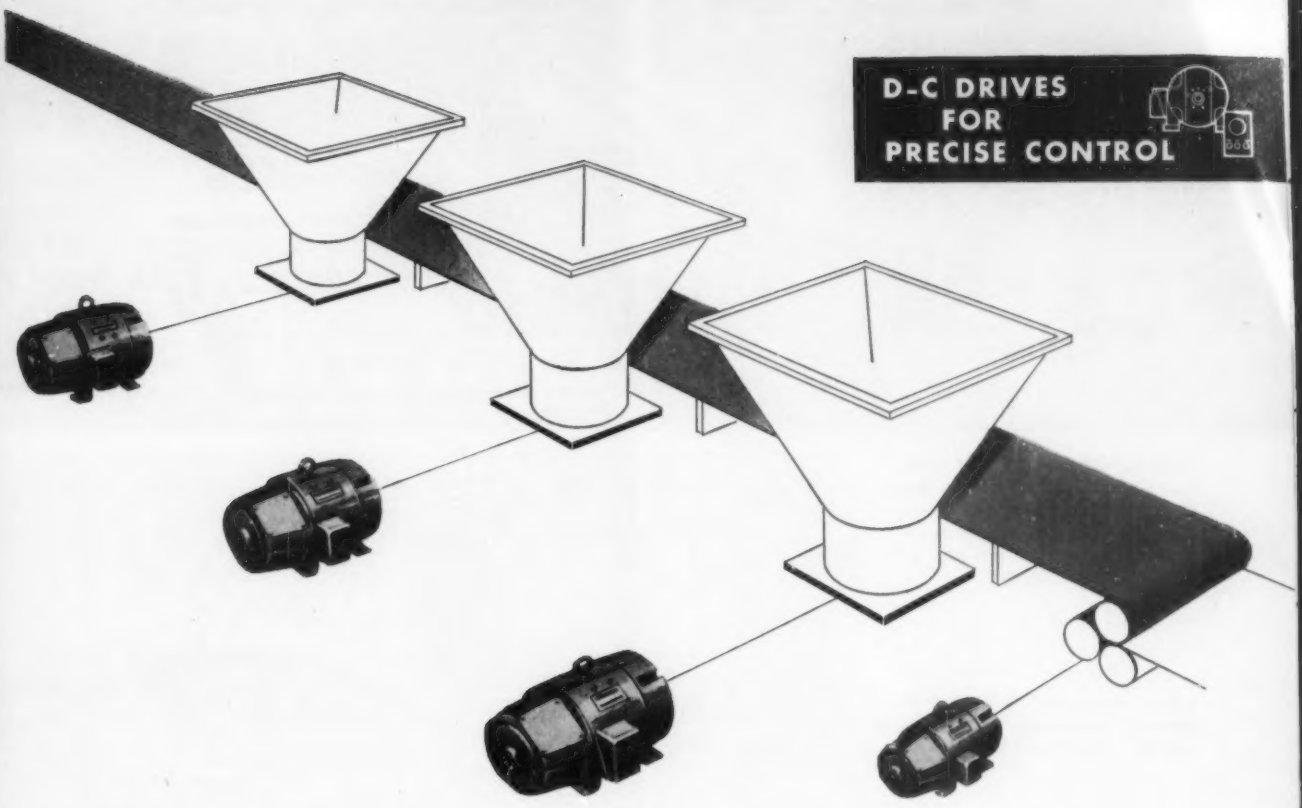
COLUMBUS, OHIO—A unique program of irradiating specimens for individual companies conducting research is being expanded by Battelle Memorial Institute here. Most other reactors are wholly or partly sponsored by the Atomic Energy Commission so that subsequent findings must be made public. Private reactors are not available for competitive reasons.

Battelle up to now turned away companies seeking only irradiation services but will now expose a company's sample to radiation and then ship the specimen back to the company for its own research study. Reason for the policy change: recent increases in power level, and experience gained by Battelle's reactor facilities, operated longer than any other privately-owned industrial reactor in the US.

Battelle has already performed such services for GE, Westinghouse and the Navy, having irradiated fluids, components and various materials. ■

USSR Short on Tools for Its Oil Industry

Moscow—The Soviet oil industry is suffering from an "acute shortage" of certain control and measuring instruments necessary for production, according to a government official, who charged in a letter to *Pravda* that important instruments such as manometers and thermometers are faultily constructed. Author of the letter was S. Nazarov, member of the State Scientific and Technical Committee of a Council of Ministers. ■



Problem: How to control machine speed ratios for accurate proportioning, continuous flow

Keeping the blend accurate in proportionate mixing requires a high degree of machine coordination. Inaccurate speed matching of mixers or conveyors can result in poor product quality, inaccurate measure, wasted material.

ACCURATE SPEED MATCHING IS A NATURAL JOB FOR DIRECT-CURRENT POWER. For only direct current can provide the split-second response, wide speed range and precise control vital to modern, automatic machines.

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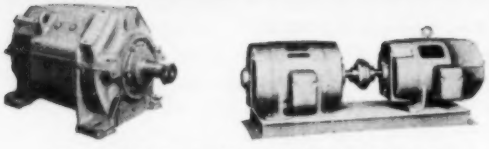
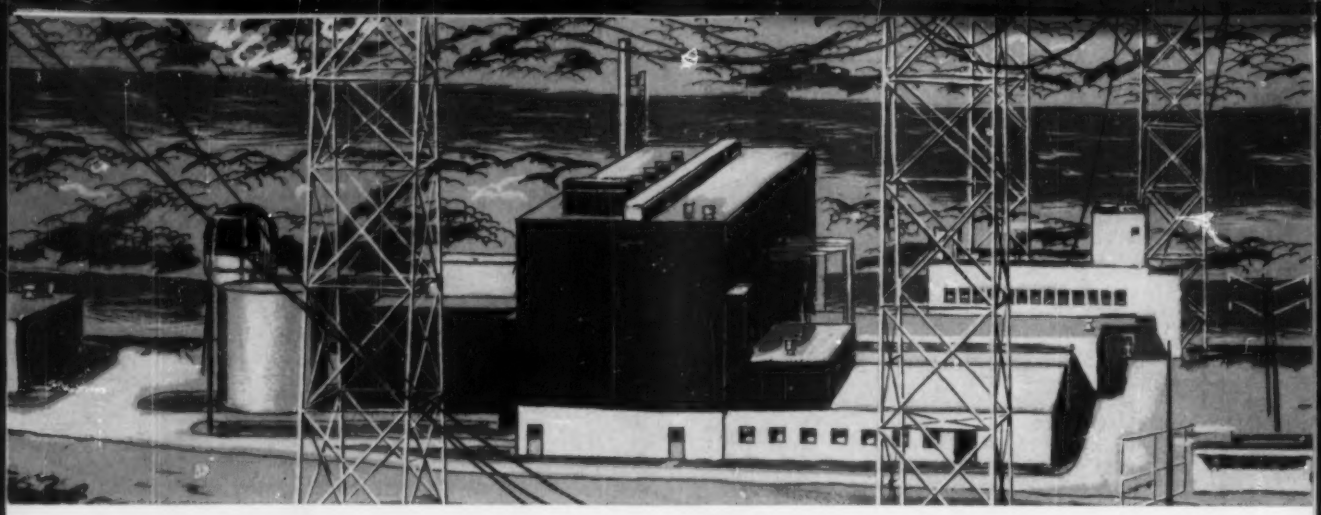


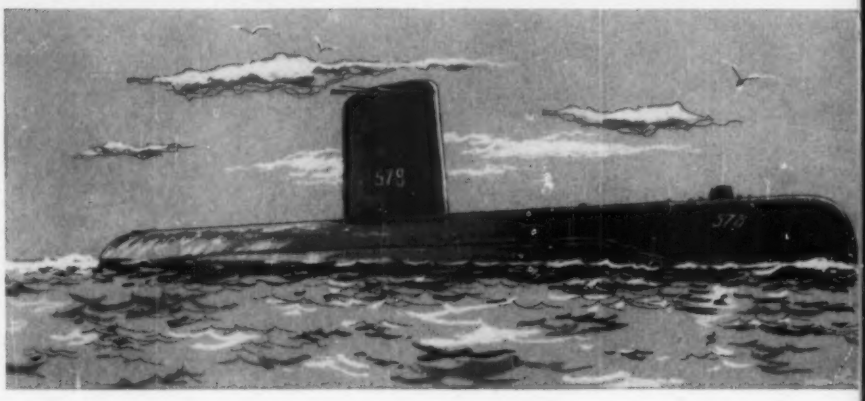
MOTORS AND GENERATORS

POWER UNITS AND CONTROLS

CIRCLE 21 ON READER SERVICE CARD

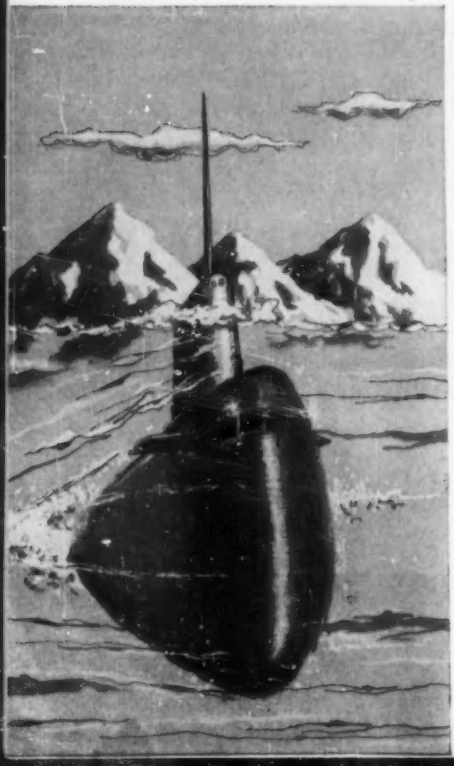


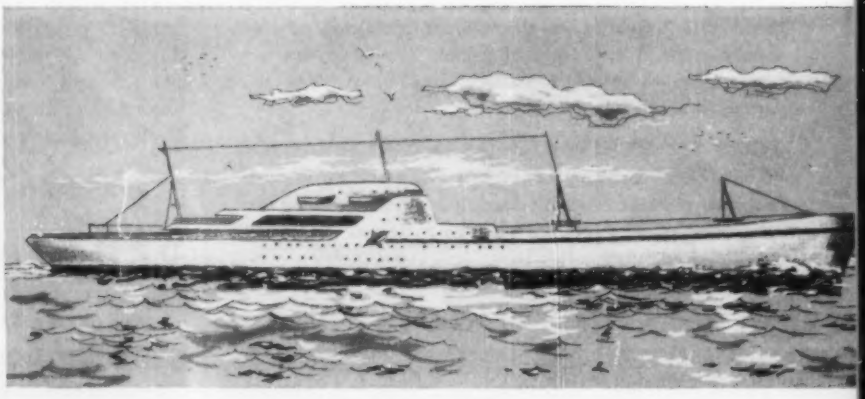
Shippingport Atomic Power Station—first United States full-scale central station atomic power plant devoted exclusively to civilian needs. First produced power on the line 12:39 A.M., December 18, 1957.



U.S.S. Skate—world's third nuclear-powered submarine. Crossed North Pole on August 11, 1958.

Next time you have a heating problem, remember...

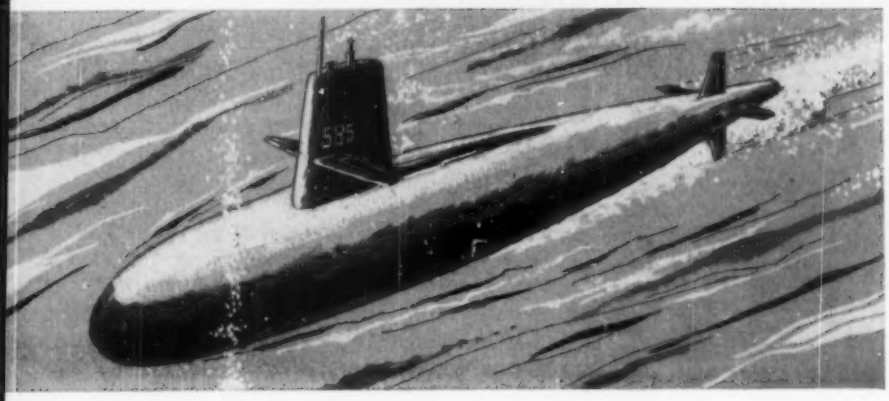




N.S. Savannah—world's first nuclear-powered merchant vessel. Launched July 21, 1959.

U.S.S. Nautilus—world's first nuclear-powered submarine. Completed first transpolar voyage August 5, 1958.

Enterprise — world's first nuclear-powered aircraft carrier. Now under construction.



U.S.S. Skipjack—world's most maneuverable submarine. Sea trials completed March 10, 1959.

CHROMALOX Electric Heat *solved* heating problems for all these projects

Heaters are installed in the primary systems of pressurized-water-type nuclear reactors to maintain the desired pressure control. *Each of the nuclear power projects illustrated uses hundreds of special Chromalox electric cartridge type heaters for this purpose.*

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CIRCLE 23 ON READER SERVICE CARD

China drives toward her own

SOL SANDERS, Tokyo Bureau
JOHN KOLB, associate editor

History has never before seen anything quite like this. A vast, backward nation is attempting to leap almost overnight into the 20th century. Her method is to draft scientists, engineers—and the entire population—into a technological machine that will take orders dutifully, yet be creative.

■ China, the world's most populous nation, is now feverishly engaged in her first R & D program. Her Communist rulers have accepted a challenge without precedent in history. Even Russia's vast "Five Year Plans" did not have to move so fast and so far.

Peiping's program has been underway long enough now to supply evidence for appraisal. The situation is fascinating—complicated by many contradictions. Only recently China erected her first windmills. To spur agriculture, and with steel short in supply, she has built wooden cultivators —with wooden gears. Visitors point to many such technological deficiencies. And yet they also report advances in machine-tool manufacturing that are eye-opening—and China has even begun building computers.

China's problems—and hopes—are common to all the underdeveloped, newly independent countries of Asia and Africa. All must accumulate sufficient capital and transform it into the instruments of production if they are to hoist their peoples into the 20th Century. And China must do this in a life-and-death race. It has the fastest growing population in the world.

China is progressing fastest of all the nations that are being "born again." Besides speed, these three basic characteristics of her development make her the most fascinating to watch.

1. Her science and technology should provide the first blending of world engineering practice. Some 9000 of the 32,000 scientists and engineers reportedly affiliated with major institutes and enterprises were trained in Japan, the US and Great Britain. They include men renowned in physics, geology, jet propulsion, engineering design and mathematics. Since completion of the anti-Kuomintang revolution in 1949 most Chinese studying outside the country have attended Soviet schools.

2. China has a scientific tradition closely resembling that of the West. And it goes back a long time, and through many developments—discoveries in magnetism, principles of the lever, mathematics . . . and, of course, solid claims to the invention of paper, movable type and gunpowder.

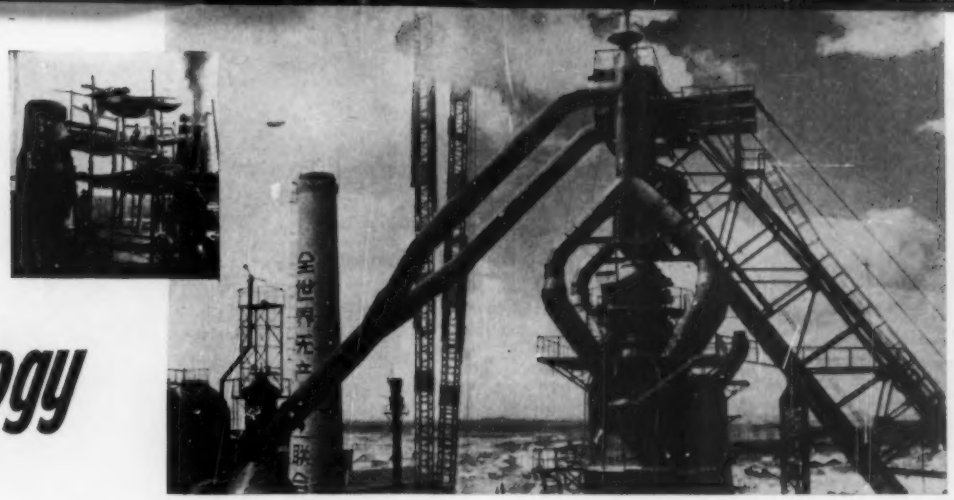
3. China has imposed on herself certain limitations and benefits by adopting and supporting the Communist system. When the Communists took over, they did so in the name of science—to them, Marxism-Leninism is the only scientific analysis of history. Yet, since then, China's scientists have been largely non- or anti-Communist, just as most of them previously had not supported Chiang Kai-shek. Like most of China's other intellectuals, the scientists have, instead, supported the so-called Democratic League, which stands somewhere between the Communists and the Nationalists. Several years of Communist rule apparently have not changed this attitude towards the government—most of China's leading scientists have attacked the regime's approach to scientific work. Of course, these same scientists cannot help being aware of the unstinting financial support Peiping is giving to scientific and technological research and development.

Two-legged Compromise

Two creative forces are being merged for China's industrialization. One is modern engineering and production technology, the other, traditional techniques long used by workers and peasants. This concept, called "walking on two legs", gets major propaganda emphasis.

Such a policy poses the problem: When should each method be favored? The English language *Peking Review* answers, "When deciding on a technical policy, one must not only consider whether the technique concerned is itself modern; economic and political conditions and the cultural levels of the masses must also be taken into account." The same article asserts, "In the very process of implementing the policy of simultaneous employment of modern and traditional methods, there is a tendency toward their integration."

This problem and the policy adopted by the Chinese are not unique. India, faced with the same industrialization challenge, is trying the same on a much smaller scale. Of all the recently resurgent nations only Japan has been able to successfully employ, side by side, the levels of



This blast furnace is the first full-scale one ever to be constructed in coastal Chekiang province. It went into production last October, about a year after the village blast furnaces (inset) that had dominated the scene in communities all over China had begun to disappear.

technology

production vastly different in amount of modern technique employed. Much of Japan's success comes from the heavy protection afforded its handicraft industries by the government during the period of transformation from a primitive agrarian society into a modern industrial state.

There is at least one indication that China is following similar policies. Until recently one of the foremost carvers of precious and semiprecious stones was working in Hong Kong. He fled Peiping with the change in power in 1949. Peiping's officials lured him back with promises of a complete workshop of his own design and establishment of a school for apprentices in this ancient Chinese art form. These promises have been carried out.

Help and Equipment from USSR

Most of the "foreign methods" and equipment employed by the Chinese so far have come from the USSR, under agreements dating back to 1950. These are responsible for such arrangements as joint scientific and technical commissions, protocols of cooperation between respective academies of science, exchanges of information, and actual design and engineering aid for everything from individual agricultural and industrial machines to complete plants. During these years, the Soviet Union and its allies have committed themselves to aiding the design and construction of 211 Chinese enterprises including steel mills, shipbuilding, railway construction, chemical plants, textile mills, machine-tool production. A Soviet-built heavy-water atomic reactor began operation in China last year. The first Chinese digital computer was trial-produced last year, also with Soviet aid.

While exact value of this assistance is difficult to estimate, the Chinese insist its importance goes far beyond actual volume or cost.

They have been cut off from most Western sources of consumer and industrial products. Since the revolution largely because of US policies. Today, this potential market is probably lost because it is now based almost entirely on Communist-bloc technology, standards and design philosophy. And the Chinese are beginning to reciprocate. They claim that under an agreement signed early this year they are to supply the USSR with certain technical data for ships, pumps and mining equipment.

Like Czarist Russia, pre-1949 China had a scientific organization of world renown, the Academia Sinica, which embraces most aspects of technology and engineering. In 1949 the new regime took charge of it and has expanded it rapidly. Today, branches exist in every province. The pace of this growth was indicated by Kuo Mo-jo (president of the Academy and famous throughout the world as an archaeologist; he is also a popular poet and writer) when he reported last year that 68 research organizations were under Academy control in 1957, compared with 31 in 1952. The number of people working for the Academy increased in this same period from 5000 to 17,000. "Yet," he went on, "we still feel the need of men, since some individual units have only a few high-grade research workers."

Some additions to the Academy include what the Communist leaders call "local cadres"—Communist Party organizers, teachers, skilled workers and able farmers who have shown some aptitude for science and technology. Occasionally, they have been put in charge of scientific research programs.

Scientists Object

Repeatedly the mainland press carries stories about scientists who have confessed their refusals to accept the interference of such colleagues.

An editorial in the Peiping *People's Daily* last January stated the government's position that "research work, though it may not appear to be urgent for present-day production, may yet open new avenues for production." This editorial continued, "Our present theoretical research is not too wide; it is too narrow. Therefore research work must go on and must be supported by men and material, even if at the moment its usefulness cannot be perceived."

Chinese technology now is being guided by a 12-year plan adopted in 1956. Inspired by USSR national economic plans and based on research by experts in many fields, this blueprint sets 57 broad scientific and technical steps to industrialization. Last year was proclaimed the year of the "big leap forward"; incredibly high goals were set for agricultural and industrial production. This program had the enthusiastic support of most Chinese despite rapid shifts in emphasis. A Belgrade paper in July reported: "Approximately a year ago the well-known campaign for iron and steel was in full swing . . . hundreds

土產的科學研究

All-purpose, three-wheel truck for agricultural use was first trial-produced in Mukden, northeast China, last year. It was designed to haul loads up to 2 tons, generate electricity, saw lumber, husk grain and cut chaff (above). Trucks in background of large picture are Chinese-manufactured, comparable with Studebaker's 1949 model

of thousands of native furnaces (were) erected in all the vacant spaces in villages and towns. For months these furnaces smoked day and night, and then the campaign passed and not a trace . . . was left.

"Today a new campaign is on the agenda, and a new picture has come to take the place of last year's . . . Almost in the same spaces where iron foundries were hurriedly erected . . . there are (now) pigsties, poultry pens, and stables for dairy cows or beds for cabbage and other vegetables . . ."

". . . the explanation . . . apparently lies precisely in the character of the campaign for the big leap ahead last year . . . hundreds of millions of people were mobilized exclusively for the attainment of record increases in grain, rice, iron and steel, whereas all other branches of the economy remained in the background . . ."

Even with this popular support, the big drive has fallen short of its ambitious aims. The government was forced to admit that production claims for 1958 had been inflated. Although this meant reducing current production goods, the new figures for 1958 (8 million tons of steel instead of 12—a gain of 50% over 1957 still indicate phenomenal gains.

The lack of trained personnel—a chronic problem besetting all the economic and scientific plans—no doubt contributed to this setback. According to official figures, there were 42,000 teachers in Chinese schools of higher learning in 1955. While this was one-and-a-half times the pre-1949 figures, the growth was not enough to handle the increased number of students.

There is also a serious disproportion between the number of those finishing Chinese senior middle school and those matriculating at colleges and universities.

As in the Soviet Union, there is a large trade-school system. About two years ago China's training program for engineering technicians was merged with these trade schools.

On Ability Alone

Entrance to the engineering schools would seem to be on ability alone, according to one University of Harbin graduate now working in the US. However, children of working class parents may get favored consideration. It has been asserted that there is a tighter organization of engineering education in China than in the US, with greater breadth and variety of curriculum. As of 1957, there were 12 major engineering schools in China, each housing from 2000 to 4000 students. The average student spends four to five years at his engineering school, and he is generally assigned to jobs within his field for summer vacations.

The question of how technology is to be taught is openly debated in the press. Science, of course, is emphasized to the exclusion of almost all other subjects. This is encountering opposition from teachers—possibly from students too. But the two crucial questions are: Should basic courses be combined with specialization majors and correllated to actual practice? And should the theoretical side of the basic courses be retained? Japanese visiting China recently tell of engineering graduates with diplomas qualifying them as "machine-tool engineers"—but ignorant of mechanical engineering. On the other hand, the Harbin graduate mentioned above says he knows of engineers with such degrees who would rate as full-fledged "ME's" in the US.

All Do Manual Labor

Of one thing there is no doubt: Students, writers, artists, scientists, engineers and teachers periodically leave their work, classes and studies, and go either into the countryside to work beside the peasants in the fields, into the factories to work on machines, or to construction jobs to perform manual labor. In 1958, for example, 300 scientists carted earth for the San Chiang dam on the Yangtze.

One reason for this may be the widespread enthusiasm of most sections of the Chinese people for the remaking of their country. This is particularly true of the youth. Then there is the power of public opinion.

The labor programs make of manual labor an honorable and socially necessary thing. This probably works two ways, because it must also alter the traditional hostility and mistrust of the Asian peasant for the city dweller, the intellectual and government official.

The educational job facing Red China's authorities goes still farther. They must also raise the general level of education of the entire Chinese people, who were almost all illiterates before 1949. And this must be done in a country that has no common spoken language, and which has had to communicate through the difficult and innumerable Chinese ideographs. The Mandarin dialect has now been made mandatory in all school curricula.

This sower, specially engineered for mountainous areas, was still under development when photographed last year with its designers, Sun Pao-chuang (left) and Mao Chieh-yung, members of the Agro-mechanization Institute of the Academy of Sciences.

NOTE: The authors express their appreciation of the valuable assistance of Donald Klein, affiliated with the Men and Politics in Modern China, research project, Columbia University. K. H. Lo of the University's East Asiatic Library provided important data.

At least in theory, the government is now committed to adopting a phonetic alphabet, and one is already being used to telegraph messages, in libraries and lexicography, and for various technical purposes. It is also being used to teach Mandarin.

Another language problem, although relatively minor, is English. Since the arrival of Europeans in large numbers over a century ago, English has served as China's main language contact with the outside world.

But since 1949, Russian has become of major linguistic —and political—importance. This has changed the cultural pattern for many of China's intellectuals, particularly the scientists and engineers trained in the US and Great Britain. The press, of course, has occasionally conducted anti-English campaigns. The problem is to continue the English language as one of the necessary languages of science and technology without its becoming a rallying point for western ideas.

Once the Chinese student has graduated and takes his first job he finds his pay is above the national average but, as in the US, not as high as experienced skilled workers with good production records.

Like beginners in anything, the Chinese engineer is likely to make mistakes. If his political record is satisfactory he is more likely to escape serious consequences. Political reliability can also affect advancement and the pace at which the engineer's income increases, although there is a generally observed seniority system with job ratings that carry specific salary levels.

Politics and Engineering

Politics also may color professional judgment when a Chinese engineer selects design procedures or systems. His proposals are safer if he can show that they are based on Soviet practice.

As with other nationalities, Chinese engineers—men and women—share their social life with people having similar backgrounds and interests. This is partly because of living accommodations. Bachelor engineers employed in a particular office or plant are likely to live in something like a dormitory, three or four to a small room for which the rent is extremely low. They eat in large dining rooms generally integral with the dormitories.

Married engineers are likely to have a 2-room apartment regardless of family size. Though housing in cities is, surprisingly enough, somewhat better than in the Soviet Union, anything like luxury accommodations or private homes are very few. Housing is relatively better because, as new plants are built, housing is built with them.

In a fast-growing economy such as China's, occasional material shortages and other such tie-ups can cause shutdowns. In such cases, worker and engineer alike are laid off at full pay, but must report to work at the regular starting time each day.

A Meeting Starts the Day

Each day starts with meetings throughout the plant, generally between 7 and 8 am. They are mainly political in character, to let the working force know about decisions, programs and propaganda material.

Achievements of China's engineering and production are more easily and accurately assessed than any other sector. Again, the "walking on two legs" concept is evident, because modern, Western-style machinery is being made in large quantities together with more primitive equipment based on traditional arts and crafts.

According to mimeographed instructions of 8th Bureau, Ministry of Machine Building, dated May 25, 1959, it had become necessary to send special technical teams into some of the plants producing electric motors, steam turbines, boiler transformers, electric cable and insulating equipment. Product quality had "fallen . . . seriously."

Coils and iron cores were being shipped that were dimensionally unstable when heated. In another case, armature slots had to be hand-filed, requiring the time and labor of 300 workers, about one-third of the entire staff in the factory to which they had been shipped. Turbine blades and blade wheels in a Shanghai plant were roughly finished and needed repair before they could put into use.

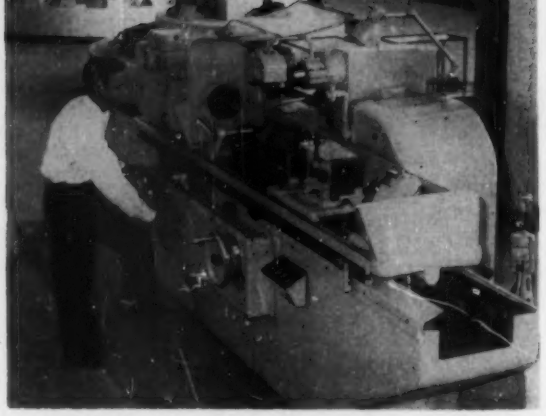
Of the electrical relays manufactured in Ahch'eng, 64% of those from one plant were found to be unsatisfactory, and 23% of those from a second. None of those from three other factories were up to standard.

What about materials for these electrical products? Engineers found that 33.1% of the castings made in the Harbin Electric Motor Plant in Jan, '59 were unusable. Poor quality was noted in the products of the Shanghai Mica Plant and the Peking Insulator Factory. These materials were apparently shipped without checking them first.

The government report cited many reasons for the trou-

(right), formerly unskilled, now operates tool-making machinery and is said to assist in tool design.

12-year-old Chang Kou-tiao has been honored by his government and peasant-neighbors for inventing a hand-operated water lifter.



Grinding machine is said to be Chinese-engineered and intended for production purposes in the aircraft and automotive industries. It seems to combine elements of standard grinders and lathes, as known in this country. Wheelhead is mounted for vertical movement on its own ways. Capable of imparting either rotary or longitudinal motion to workpiece, machine can be used for cutting splines, gear teeth, fluting, and precision flats.

ble: too much emphasis on increasing production at the expense of quality; lack of attention to standards; inadequate inspection procedures; need for better maintenance of machinery and equipment, better operator training.

Yet Japanese engineers who have seen the machine-tool plant in Wuhan in operation came away admiring it. This plant is five times the size of the Shibaura Works in Numazu, Japan, until recently Asia's largest. Soviet and Czech machine-tool experts were in charge of the construction of the Wuhan facility.

The Japanese visitors were also impressed with the quality and size of large-scale machines they saw, including a 12-meter long, 4-meter wide planer, a copy of a Soviet tool. The Chinese expect the Wuhan plant to provide for all their immediate small machine tool needs. In fact, earlier this year it was recently announced that some small metal-cutting equipment was exported to Eastern Europe.

The Japanese engineers found no machine tools of original design. There were copies of Soviet, Czech—or, in some cases, copies of Soviet versions of what had originally been Western European or American equipment. The Chinese who conducted the visitors through the plant made no claims of design originality, but stressed instead the more important production needs that were being met.

Copying extended beyond the machine-tool field too. A number of Japanese designs were noted—diesels, steam locomotives, bicycles, all of good quality.

While large deposits of oil have been reported in Western China, they are so far from rail-heads that they cannot relieve the present fuel shortage for several years. To overcome this problem, Chinese engineers have designed a number of charcoal-operated machines, including a 10-hp generator set and a 25-hp tractor.

Designed for Wood

To compensate for lack of steel, designs have been developed that use only wood. One such product is a good-sized agricultural cultivator. Even its gears are wood, covered with sheetmetal at key load and wear points. This machine is oiled with pork fat. Such equipment is expected to last a year or two, at most.

Railroads are steadily being expanded, and the Chinese claim to be producting sufficient rolling stock for their present needs. They have an amphibious vehicle, between two and three meters long, that has wooden wheels for land and which floats readily on water. In south China, windmills have recently been built for the first time, and last spring an experimental lighting system is said to have been devised in one village, using methane gas from human and animal sewage.

But there is another side to the situation. The same Japanese visitors saw a sewing-machine plant in Canton which produces for export but has never organized an assembly line worthy of the name. A diesel engine plant in Shanghai made every part of the final product itself, down to the last nut and bolt . . . a practice characteristic of production technique long discarded in the US.

Steel Instead of Cast Iron

Too often, high-grade steel is being used where case iron would be both more effective and cheaper. Glass is still commonly used in applications where plastics have taken over in Western products. The Japanese engineers found advanced machine controls only in the Wuhan plant, where there were some thermostats with feedback mechanisms.

With all this, Peiping is successfully exploiting a great wave of enthusiasm and energy generated by the fact of independence and the practical, tangible goal of industrialization that it holds out as the basis of lasting national sovereignty.

But there are serious questions. Is this burst of energy and enthusiasm enough to carry these people through the extended period of transformation that can make them into a modern state? Can the process of capital accumulation proceed fast enough in the face of the steadily mounting drain imposed by an exploding population?

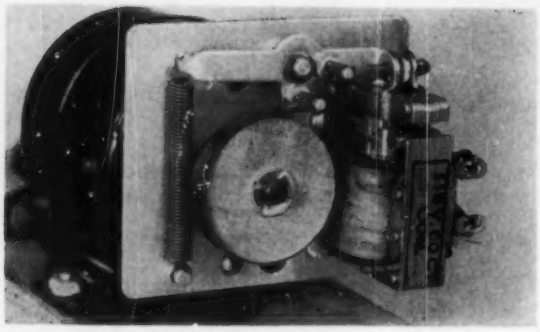
Will the government's policies towards scientists and engineers hold back necessary research and development—or will they win allegiance from these architects of industrialization?

Only time will tell how long the conflict between regimentation and free inquiry will continue. Probably compromise will win out, because it is typically Chinese. Throughout history, China has repeatedly absorbed conquerors and made their culture a part of her own. Therefore we can look forward to a technology molded by the "walking on two legs" concept. ■

SIGNIFICANT COMPONENTS

behind-panel depth of $\frac{7}{8}$ in. Switchlight

SIGNIFICANT COMPONENTS MATERIALS PROCESSES



Low-cost brake for fhp motors . . .

has braking torque of 2 to 4 in.-lb for shafts up to ⅜ in. All parts, including brake band, are made with special dies, eliminating variation in braking power. Utilizes a band that almost encompasses brake drum. Constant-duty solenoid, furnished in ac only, is connected in parallel with motor. When motor is activated, solenoid depresses pivoting arm, which loosens brake band. When power to motor is cut, solenoid releases pivoting arm. Stainless steel spring pivots arm upward, tightening brake band against shoe. Without load, motor is reported to stop in less than one-quarter revolution. Suitable for use in stopping over-travel on various mechanisms where positive stop is necessary. Standard assembly, in lots of 1 to 50, $5.65 each; in lots of 50 to 100, $5.20 each. Prices FOB Des Moines. **Midwest Automatic Control Co, 510 3rd St, Des Moines 9, Ia.**

Circle 101 on Reader Service Card

High-pressure needle valve . . .

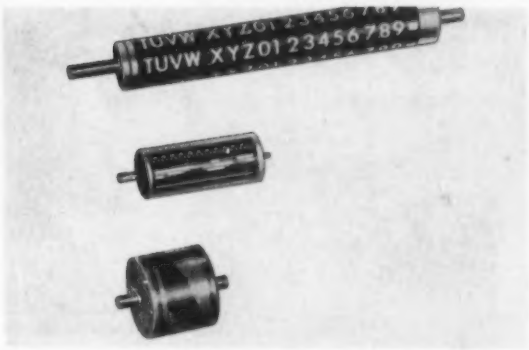
has conventional needle stem coupled directly to pneumatically-operated diaphragm mounted on valve body, producing overall height of 5 in. Ratio of line pressure to control is in excess of 200:1, giving it operating pressure of 10,000 psi with less than 50 psi control pressure. Conventional methods of control are used, an electrically-operated solenoid valve for straight open and close or an electrically-operated solenoid valve with low-pressure regulator for metering and pressure relief applications. Offered in choice of body and stem materials in sizes ⅛ through ½ in. NPT as well as AND 10050 tube sizes 4 through 8. Priced from $30 to $40. Delivery from stock. **Dragon Engineering Co Inc, Box 185, Norwalk, Calif.**

Circle 102 on Reader Service Card

Photoelectric shaft-position encoder . . .

gives angular position data in 17-digit cyclic binary code with ±1 digit accuracy. 17-digit accuracy for 1 shaft revolution is obtained in unambiguous form without gears. 26-lb, 10 in. dia unit includes power supplies, amplifiers and control electronics. Consists of glass disk coded by array of opaque and transparent segments, flash lamp to illuminate radius of code disk, multi-element photo-sensitive light detector, 17 transistor-equipped amplifier channels and all power supplies and control electronics. Unit operates from 115 v, 60 cps or 400 cps primary power. May be used wherever it is necessary to read shaft position in digital form, either for recording on magnetic or punched tape, or for application to a digital computer. Modular, plug-in electronic assemblies are easily replaced. About $600, 60 to 90-day delivery. **Wayne-George Corp, 588 Commonwealth Ave, Boston 15.**

Circle 103 on Reader Service Card



Imbedded-circuitry code drums . . .

and switching drums are for use in control devices. Shafts can be metals or nonmetals; any size, diameter or length. Can be machined to specifications. Conducting area can be any metal or alloy and can be plated with gold, silver, rhodium or other materials. Insulation is epoxy or other resins, with or without fillers, flush with conducting areas. Drum can be hollow, solid or filled with insulating material. Available in ¼ to 4 in. dia, any length. **Beck's Inc, 300 E 5th St, St Paul 1.**

Circle 104 on Reader Service Card

Large forged tungsten parts . . .

are possible through a process developed by Metallwek Plansee in Austria. Permits production of large components not only from tungsten alloys, but also from pure tungsten. In this procedure, tungsten powder is compacted to ingots of, for instance, 8 x 16 x 25 in., which are then sintered in large-capacity furnaces, subsequently forged to preforms at high temperatures and, finally, sintered again. Compacts up to about 250 lb can be sintered in tiltable push-type furnaces, while batch-type furnaces must be used for larger components. Furnaces recently developed permit sintering of pure tungsten ingots weighing 900 lb. Custom parts can be delivered in 3 to 4 mo, which permits time for tooling. **Schwarzkopf Development Corp, 595 Madison Ave, New York 22.**

Circle 105 on Reader Service Card

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Hall-effect transducer . . .

supplies dc milliv signal proportional to measured ac watts for application to a control device. Said to perform same function as thermal converter at lower cost and in less space. In control circuitry, particularly, watt transducer has microsec response speed as compared to time constant of about 1 sec for thermal converter. One version, used for driving direct-acting external instruments or control windings of magnetic amplifiers where there is no sensitivity to ac ripple, produces unfiltered dc current output in milliamp range. A second version, applied where control devices, telemetering transmitters or potentiometric recorders must have a dc signal relatively free of ripple, produces a filtered dc milliv output. Both units are for single-phase, three-phase three-wire, and three-phase four-wire applications. In production, but capacity is limited. **Westinghouse Electric Corp, Box 2278, Pittsburgh 30.**

Circle 106 on Reader Service Card

Electrohydraulic servovalve . . .

is two-stage, four-way flow control unit. Made of titanium, it has unity-coupled hydromechanical feedback, reported to reduce flow-force reactions and to accomplish hydraulic centering of pilot position without spring hysteresis and null shift. Torque motor with rated currents from 10 to 70 milliamp and coil resistance from 60 to 3000 ohm is available in 300-milliwatt input power model torque motor. Rated flow is to 18 gpm at 3000-psi valve-pressure drop. Operates from −65 to 275 F. For supply pressures of 300 to 4000 psi. Weighs 16 oz. **Kearfott Co Inc, Little Falls, NJ.**

Circle 107 on Reader Service Card

Moistureproof switch . . .

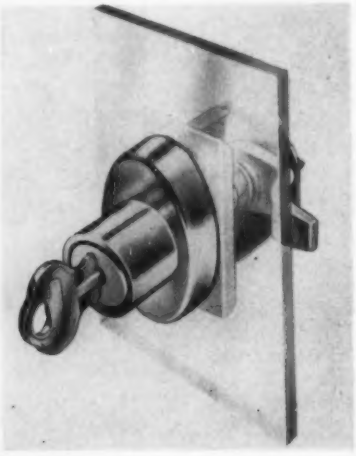
and switchlight are rated at 2 amp inductive, 28 v dc. DPDT pushbutton switch has over-all length of $1\frac{5}{8}$ in. with behind-panel depth of $\frac{7}{8}$ in. Switchlight has independent, isolated lamp circuit and is offered with 6, 14 or 28-v lamp. Lens, $\frac{3}{4}$ in. dia, provides space for engraved legend. Over-all length is $2\frac{3}{8}$ in. with behind-panel depth of $1\frac{3}{32}$ in. **Hetherington Inc, 139 Illinois St, El Segundo, Calif.**

Circle 108 on Reader Service Card

Miniature pickups . . .

have over-all dimensions of $1\frac{1}{16}$ x $1\frac{5}{16}$ x $\frac{1}{16}$ in. dia; can be mounted directly on $\frac{1}{4}$-in. pipe. Direct pickups detect interruption of light beam; reflecting-type units can monitor, register or differentiate between surface qualities or establish web motion or sag limits. **Photomation Inc, 96 S Washington Ave, Bergenfield, NJ.**

Circle 109 on Reader Service Card



Fasteners with locking . . .

assembly and adjustable pawl pull-up are dustproof and vibration-resistant. Installed by drilling or punching three holes and inserting two screws, which cannot be removed from outside. To operate, key is inserted and turned until pawl grips panel firmly. Key can be removed at any 90° position. Made in two basic sizes: one with grip ranges of 0.125 to 0.625; 0.562 to 0.937; 0.813 to 1.250 and 1.125 to 1.5—the other with grip ranges of 0.125 to 0.375; 0.375 to 0.750 and 0.750 to 1.125. **Southco Div, South Chester Corp, Lester, Penna.**

Circle 110 on Reader Service Card

Class H silicone varnish . . .

is said to be as easy to process as most Class A and B varnishes. Cures in 6 hr at 302 F, 90 F below temperatures required for other silicone varnishes. Meets AIEE requirements for use in 428 F systems. Supplied as 59% solids in diacetone alcohol. **Dow Corning Corp, Midland, Mich.**

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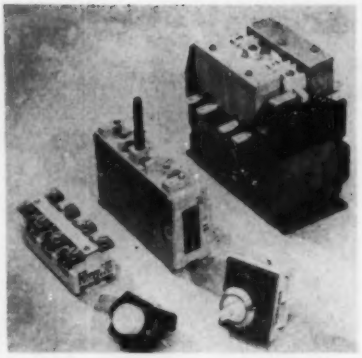


Navy control components . . .

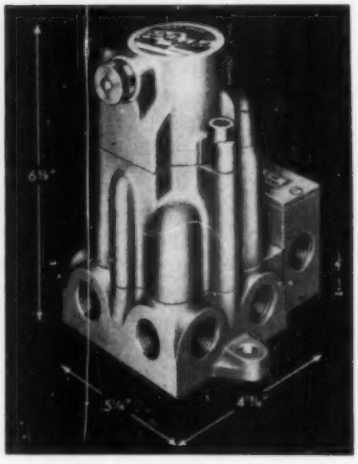
have fire-resistant compound bases and corrosion-resistant metal parts. They include ac contactors, two-pole dc contactors, single or multi-pole ac relays, dc relays, heater-type thermal overload relays, reset relays, panel-mounting pushbuttons, selector switches, terminal boards, fuse blocks, resistors, and manual starters. **General Electric Co, Schenectady 5.**

Circle 112 on Reader Service Card

5-wire devices . . .

for 4-wire applications requiring additional equipment ground are rated 30 amp, 600 v ac and 20 amp, 250 v dc. Units include male and female receptacle with metal housing and armored cap and body. **Harvey Hubbell Inc, Bridgeport, Conn.**

Circle 113 on Reader Service Card



Air control valve . . .

can be replaced in less than 30 sec because replacement parts, poppet spindle-sleeve assembly and solenoid pilot assembly, are self-contained units. $\frac{1}{4}$-in. NPT valve has flow of 335 cfm at 100 psi initial pressure to atmosphere. Made of aluminum. Available in $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{3}{4}$-in. tap sizes. Weighs 4 lb. **Hunt Valve Co, Salem, Ohio.**

Circle 114 on Reader Service Card

Valves reduce pressure . . .

and regulate air, oil, water, gas and all noncorrosive fluid service. Outlet pressures are not affected by variations in inlet pressures or variable rates of flow. In two body styles, with female inlet and outlet with or without side gage connection. Forged brass or all-bronze bodies, depending on style. In ¼, ⅜ and ½-in. sizes. Spring ranges from 2 to 175 psi, with max temperatures of 200 F. **Cash-Acme, PO Box 191, Decatur, Ill.**

Circle 115 on Reader Service Card

Tri-color pilot light . . .

measures 2 $\frac{9}{16}$ x 1 in. dia. Available in six standard colors. Enclosed unit may be mounted on 1⅛ in. centers. Relamps from front. Employs three MD-25237-327 or -328 (28 or 6 v) lamps. Priced at $15, less lamps, **Ronan Panel Co, 8156 Orion Ave, Van Nuys, Calif.**

Circle 116 on Reader Service Card

Quick-release pins . . .

are produced in four standard handle configurations and wide range of sizes. Pins incorporate four-ball locking element. Pins work even if handle is broken. **Hartwell Aviation Supply Co, 9035 Venice Blvd, Los Angeles 34.**

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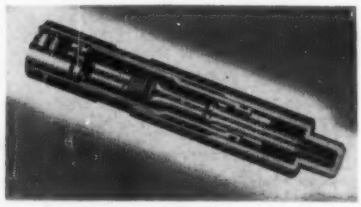

Liquid spring shock . . .

produces spring action by liquid compression between sealed area at stud head and sealed area of tubular piston providing net compression of liquid to 20,000 psi. Shock force is produced by inwardly turned dashpot head at tubular piston end plus inertia valve area. Provides 6000 lb average max force. **Taylor Devices Inc, 188 Main St, North Tonawanda, NY.**

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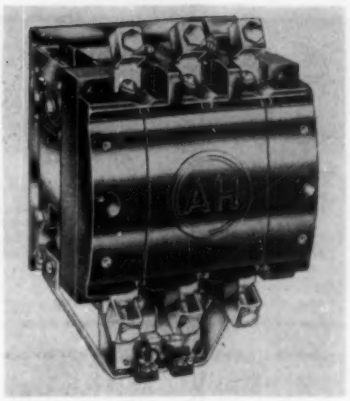


Mechanically held contactors . . .

are supplied in NEMA sizes 0 through 5, with 2, 3 or 4 poles. Closed by momentary energizing, then held closed by latch. **Arrow-Hart & Hegeman Electric Co, Industrial Control Div, 103 Hawthorn St, Hartford 6.**

Circle 119 on Reader Service Card

Digital-to-analog readout . . .

consists of relay matrix, a 2° analog-to-digital converter, and 400-cps, 115-v motor. Servo package has reading of pure binary information. Analog output is 360° on a dial in 2° increments. Accuracy is said to ± ½°. Features minor arc sensing, a function of system that enables analog movement to proceed through shorter angular distance to reach null position. Operates on input voltage of 28 v dc or 115 v, 400 cps ac. Output rate is 8 rpm max. **Kearfott Co Inc, Little Falls, NJ.**

Circle 120 on Reader Service Card

Snap-in miniature connector . . .

has insertable and removable contacts in 3, 7, 12, 19, 27, 37 and 61 shell sizes. Available in square flange or bulkhead mounting receptacles and standard or rack-and-panel-type plugs. Mates with Mil-standard miniatures and meets or exceeds requirements of MIL-C-26482. For −67 to 300 F. Rated 7.5 amp each contact. **Deutsch Co, Electronic Components Div, Municipal Airport, Banning, Calif.**

Circle 121 on Reader Service Card

Thermocouple adapter . . .

converts ⅛ or $\frac{1}{16}$-in. metal-sheathed tubular thermocouple to spring-loaded thermocouple with adjustable immersion length from 1 in. min. **Thermo Electric Co Inc, Saddle Brook, NJ.**

Circle 122 on Reader Service Card

Subminiature dc motors . . .

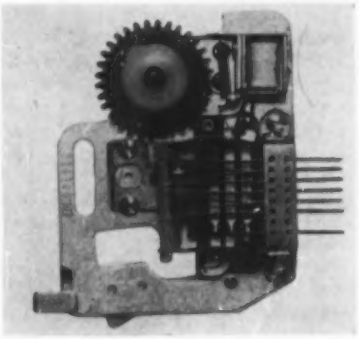
are said to have high torque, rotor inertia of 5 gm-cm² and to be reversible. Measures less than 1 in. dia. x 1⅛ in. long; weighs 2 oz. Speed tolerance of ±10% can be maintained at rated voltage. Standard units operate on 4.5 to 30 v dc. Normally furnished with integral, hardened stainless steel pinion (10 tooth, 96 dp) or with ⅛-in. dia output shaft. Temperature range −65.2 to 185 F. Dielectric strength is 500 vrms at 60 cps for 1 min. **A W Haydon Co, 232 N Elm St, Waterbury, Conn.**

Circle 123 on Reader Service Card

Magnesium cold-bending sheet

in AZ31B-O alloy is capable of bending, without cracking at room temperature, through an angle of 90° around a mandrel radius equal to bend factor times nominal sheet thickness. Axis of bend may be perpendicular or parallel to direction of rolling. Material has lower tensile yield strength than standard alloy sheet, but meets requirements of Federal Specification QQ-M-44. **Dow Metal Products Co, Div of Dow Chemical Co, Midland, Mich.**

Circle 124 on Reader Service Card



Logic switches . . .

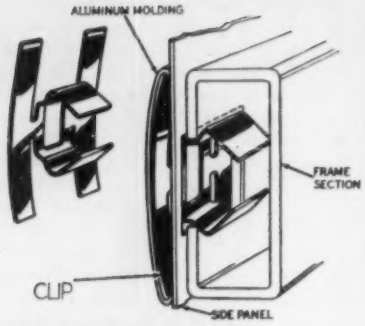
reduce to ½ pulse times necessary to resolve systems logic. Electromechanical units consist of a delay element, a bistable element and a number of AND gates associated with assert or negative side of bistable element. Switches and decimal counters are furnished separately or packaged in units such as shift registers, translators and verifiers. **Tally Register Corp, 5300 14th Ave NW, Seattle 7.**

Circle 125 on Reader Service Card

Plasticized switches . . .

are available as push-pull, momentary switches, starter solenoids, or circuit breakers. Product body, insulator and wire lead connections are sheathed in plastic coating of high dielectric strength to withstand corrosion, road-splash and chemicals. **Cole-Hersee Co, 20 Old Colony Ave, Boston.**

Circle 126 on Reader Service Card



Spring steel retainer . . . secures molding, covers, trim and other such components to housings. Clips, spaced about a foot apart, are inserted at either end of molding and moved along to desired positions. Tinnerman Products Inc, PO Box 6688, Cleveland.

Circle 127 on Reader Service Card

3½ in. panel meters . . . in military style are available in 61 standard models. Built in accordance with MIL-M-10304A, line includes voltmeters, ammeters, microammeters and milliammeters. Helipot Div, Beckman Instruments Inc, Fullerton, Calif.

Circle 128 on Reader Service Card

Instrument measures jerk . . . or rate of change of acceleration with accuracy to 0.1%. Offers linear and angular meter models. Both units provide output voltages that can be used to instigate compensatory control forces or other action. Acceleration output voltage is also available. Operates as subminiature servo system of force-balance type that is responsive to jerk along or about its sensitive axis. Range for acceleration is 1 to 30 g full range; for jerk, 0.5 to 20 g per sec full range. Size is 3 x 1½ x 1⅝ in. high. Weighs 3.5 oz. Donner Scientific Co, Concord, Calif.

Circle 129 on Reader Service Card

"I've made a list of New Year's resolutions . . . here's yours."

NATIONAL COVERAGE

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | Civil Service Opportunities | Employment Agencies
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A. W. Pomper, *Director of Engineering*
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Write P-3261, Product Engineering
520 N. Michigan Ave., Chicago 11, Ill.

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Applicants should have graduate degree or equivalent experience in fields of (1) Pressure Vessel Analysis, (2) Composite Structure Analysis and (3) Plastic-Elastic Behavior of Materials. Familiarity with Shock and Vibration Analysis helpful but not a requirement.

The work is varied and challenging for persons having the ability to generate and direct testing programs and will lead to increased supervisory responsibilities.

Submit resume with full particulars to:

MR. W. D. LINKENHOKER
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Aggressive responsible engineer who can get things done quickly and accurately. Degree or equivalent, with machinery design experience and preferably some knowledge of plastics extrusion. To assist Chief Engineer in supervision of extruder design department.

Please write describing experience, education, salary requirements to A. W. Pomper, Director of Engineering

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Chicago 11 . . . Mid-Western Adv. Sales Manager, A. E. Meanor; R. W. Bruley, L. Anderson, 520 N. Michigan Ave., Mohawk 4-5800

Cleveland 13 . . . A. F. Tischer, 1164 Illuminating Bldg., 55 Public Square, Superior 1-7000

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Denver 2 . . . John W. Patten, 1740 Broadway, Mile High Center, Alpine 5-2981

Detroit 26 . . . P. B. Robinson, 856 Penobscot Bldg., Woodward 2-1793

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St. Louis 8 . . . R. W. Bruley, 3615 Olive St., Continental Bldg., Jefferson 5-4867

San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600

NEW LITERATURE

Men and Atoms

WILLIAM L LAURENCE. Simon & Schuster Inc, 630 Fifth Ave, New York 20. 5¾ x 8½, 302 pp. $4.50.

Scientists and engineers often claim that political leaders fail to see the woods for the trees. In this book, the *New York Times* science editor shows, as he describes the birth of the Atomic Age, that scientists themselves had this failing. Laurence takes the reader behind the paper curtain of censorship imposed on atomic development in the US from Pearl Harbor through the Hiroshima bombing.

Among examples he gives of faulty vision that had international repercussions were Enrico Fermi's blindness to the fact that he had split the atom in 1934 (a thin piece of aluminum foil served as the impairment), and Irene Joliet-Curie's misinterpretation of her findings after she duplicated Fermi's experiment five years later. In our own country, Laurence continues, development of atomic power was delayed at least two years when US scientists ignored a Columbia Univ engineer named John Dunning (now dean of the university's School of Engineering) who held that gas diffusion was the most efficient way to perpetuate a chain reaction.

But, according to Laurence, still farther from reality were the world's political leaders. Adolph Hitler failed to press for development of the bomb early enough even though two of his countrymen—chemists Otto Hahn and Fritz Strassman—were the first to split the atom and realize the importance of what they'd done. The Roosevelt Administration, the author reveals, did not provide sufficient funds until well into World War II to complete development of the A-bomb.

Laurence describes his own efforts to alert Americans to the possibility that Germany would build the first A-bomb. He goes on to give his story-gathering experiences in the super-secret cities of Oak Ridge, Alamagordo and Hanford where such now-revered names as Teller, Fermi and Oppenheimer, worked feverishly under assumed names, and gives a vivid, eyewitness account of the bombing of Nagasaki.

In this age of fear, Laurence's optimism about the future envisioned in terms of beneficial uses to which atomic energy can be put is—if not inspiring—at least refreshing.—RSP

INDUSTRIAL SCALE MODELS—Brochure, 32 pp. Describes and illustrates typical uses in electronics, industrial engineering, nuclear training. Atkins & Merrill Inc, Sudbury, Mass.

Circle 140 on Reader Service Card

THERMAL DESIGN—Technical report 7-8-9, 4 pp. Describes and analyzes thermal problems affecting electron tubes in modern electronic equipment. Research Council Inc, 1062 Main St, Waltham 54, Mass.

Circle 141 on Reader Service Card

POLYETHYLENE RESIN—Brochures, 8 and 4 pp. The first deals with extrusion coating and contains a property selector chart. Other makes note of some two dozen polyethylene applications. E I Du-Pont de Nemours & Co, Wilmington 98, Del.

Circle 142 on Reader Service Card

STANDARD GATE VALVES—Brochure, 4 pp, and tracing templets. Includes specification tables, dimension tables and actuator configuration tables for entire line of off-the-shelf gate valves Actual-size outline drawings on templets are in back of brochure. Dept SMA 550, Whittaker Controls Div, Telecomputing Corp, 915 N Citrus, Los Angeles.

Circle 143 on Reader Service Card

CUSHIONING MATERIAL—Free test samples of fuel and weather-resistant cushion developed for line clamps, instructions and specs. TA Mfg Corp, 4607 Alger St, Los Angeles 39.

Circle 144 on Reader Service Card

Letterhead Requests Only

Manufacturers who published following literature asked that requests for copies be made on company letterheads.

MOTORS, ACTUATORS—Brochure EE-100, 36 pp. Covers facilities and products available, including ac and dc motors, linear and rotary actuators, gearboxes, turbine controls and electromechanical systems. Also describes specific applications of these devices. Eemco Div, Electronic Specialty Co, 4612 W Jefferson Blvd, Los Angeles 16.

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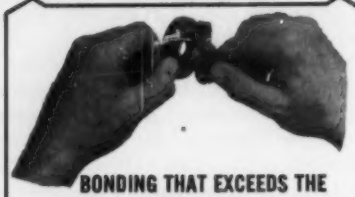

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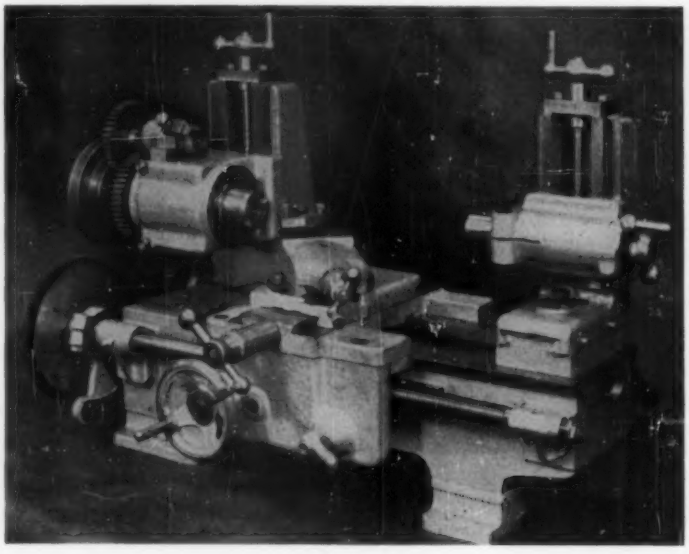
For Your Information (personal)

Lathes for less than £40

That's British, of course; but the American equivalent is barely $100; Murad Developments Ltd, Aylesbury, England, designed this machine which will mill and bore as well as turn, and can be converted into a woodworking unit—for dovetailing, grooving, molding, and sanding.

Bed is 22 by 6 in.; distance between centers, 10 in.; and center height can be varied from 3½ to 7 in. It's powered by a ½-hp motor, and can be supplied with a variety of accessories for the different jobs.

Murad calls it the *Bormilathe*.



For a fast getaway

You can keep your battery warm this winter—and increase starting power 35% at 32 F, says Luminator Inc, Chicago 80, with a new heating element that's said to maintain battery temperature at 60 F, even in an unheated garage. It consists of a Nichrome heating coil, sandwiched between zinc-plated steel sheets, and is designed for installation in the battery bed. A 12-in. lead-in cord is attached to the unit for connection to a line from the regular house circuit. Made in 4 sizes, to fit all standard car batteries, the warmer lists at $9.95.

Sun time any time

Sun-time, moon-time, star-time, equinoxes and latitudes are all neatly explained in a 35-page pocket-size booklet that comes complete with a sundial to illustrate their meaning. The combination was originally developed as a promotion piece by GE's Large Lamp Dept, but is offered now in limited quantities at 25¢ each—and well worth its tiny price. Address GE, Dept PR11X, Nela Park, Cleveland 12. —ARG

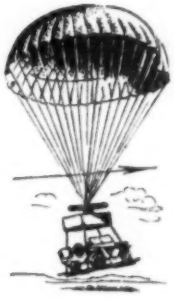
Why Don't They R and D . . .

The following problems have been encountered by the Armed Forces.

. . . an automatic machine for cutting standard, round, threaded tensile specimens from square, round, or irregularly shaped metal pieces. At present, these are machined individually on lathes with special attachments such as air tracers at an average cost of about $20 to $30. It is expected that an automatic machine would reduce production cost and produce a finished part in less than 15 minutes. One suggestion: Divide the machining operation into two steps. A preliminary rough turning or abrading operation would make a cylindrical piece from an irregular shape; then a final finishing step would transform it into a precision-cut specimen. Of course the specimen might also be cut in one step with specially designed cutters or abraders.

. . . lightweight speed reducer for aircraft turboprop and turboshaft engines. Present gearboxes are large, heavy, complex and give considerable service difficulty. In a small turbine, the gearbox can represent the bulk of the engine's weight. A speed reducer is needed that will transmit a large amount of horsepower but be simple, reliable, and have a minimum number of moving parts. Fluid couplings and electromechanical drives have features that suggest they may be suitable for such applications.

. . . an azimuth-control device that will keep airdrop platforms parallel to direction of the wind. Heavy equipment dropped by parachute in a strong wind is often damaged when it overturns on impact with the ground. This occurs most often when the long axis of the load is perpendicular to the direction of the wind. No device or method is known whereby load orientation can be controlled with respect to wind. Such a device should be inexpensive and adaptable to aerial delivery platforms.



If you think you have a solution for any of these problems—or if you wish additional information—get in touch with National Inventors Council, US Department of Commerce, Washington 25, DC.

Have you a problem, based on known scientific principles, which seems to have an answer somewhere within the limits of present technology? To inspire inventors along worthwhile paths, PRODUCT ENGINEERING invites you to trade such problems with fellow readers who may have a fresh viewpoint or more time for necessary R & D. We will pay $10 for each one accepted.

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SIGNIFICANT PARTS and NEW LITERATURE

101	106	111	116	121	126	131	136	141	146
102	107	112	117	122	127	132	137	142	147
103	108	113	118	123	128	133	138	143	148
104	109	114	119	124	129	134	139	144	149
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5	12	19	26	33	40	47	54	61	68	75	82	89	96	
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Publisher's Postscript...

What they read and why

Everybody talks about the technical literature of a field, but does anyone really do anything with it? A recent survey of engineers' reading practices in England turned up these interesting questions and some disconcerting answers.

For engineers

Have you, in your own experience, found that the best engineers are, by and large, quite knowledgeable about technical literature?

Cautious statistical analysis of the evidence suggests that the habit of referring to literature in solving a problem is not simply an incidental characteristic of the good technologist. It is not merely a result of the fact that the good technologist is more likely to be given the type of problem which calls for reference to the literature. On the contrary, it appears to be one of the characteristics which makes a technologist good.

Do you keep an index of useful literature—for your own sake and for others who may ask your advice?

A literature search seems a logical way to begin a program of investigation or a solution of a problem. Of those interviewed, 703 said they were engaged in a problem at the time. Only 12% said they had begun by consulting the literature. Only 2% of those who had worked on the problem in the 24 hours before the interview had referred to the literature during that time.

If you think there is little literature appropriate to your particular work, have you ever consulted a librarian?

The group was asked where they get most of their ideas or stimulation for new ideas or improvements. Written material was mentioned by 60%, but 12 % admitted to no external sources of ideas, saying they relied on intuition or "thought."

For managers

Are you satisfied that your technologists never waste time discovering, by trial and error, facts and procedures which could be found in the technical literature? Do you encourage your technologists to read widely, perhaps by setting aside a part of their working day for that purpose? Or do you dislike seeing them comfortably immersed in periodicals and think it a waste of time? Or do you not care, either way?

Those who see many journals do not have to skimp their reading: they both read more and scan more. It looks therefore as though the time available for reading does not limit the time spent reading. The fact that most technical reading is done at home indicates, not that there is little time for reading at work, but that the technologist—or perhaps his manager—does not regard reading as part of the job in hand.

Those questions and observations were drawn from a report of a survey of 1082 technologists (scientists and engineers engaged in R & D, production supervision or management) in the electrical and electronics industries. It was made in 1956 by the Social Survey Div of the Central Office of Information, Dept of Scientific and Industrial Research, London. Copies of the booklet "What They Read and Why" may be obtained from Her Majesty's Stationery Office, York House, Kingsway, London WC2, at 36¢ each. —SJA

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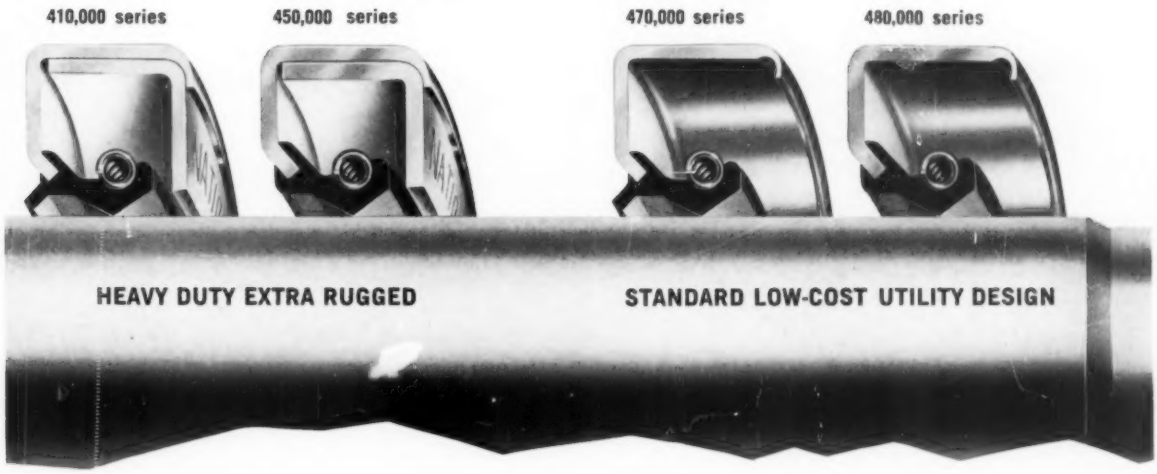

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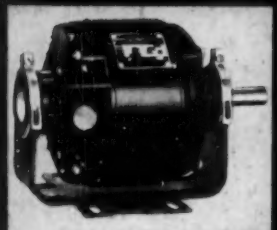

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